Energy Conservation Standards Rulemaking Framework Document for Fluorescent Lamp Ballasts

U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
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AEO	Annual Energy Outlook
ANOPR	advance notice of proposed rulemaking
ANSI	American National Standards Institute
BF	ballast factor
BEF	ballast efficacy factor
BT	Building Technologies Program
CAIR	Clean Air Interstate Rule
CAMR	Clean Air Mercury Rule
CFR	Code of Federal Regulations
CBECS	Commercial Building Energy Consumption Survey
CSL	candidate standard level
DOE	U.S. Department of Energy
DOJ	U.S. Department of Justice
EIA	Energy Information Administration
EISA 2007	Energy Independence and Security Act of 2007
EPACT 1992	Energy Policy Act of 1992
EPACT 2005	Energy Policy Act of 2005
EPCA	Energy Policy and Conservation Act
F	Fahrenheit
FR	Federal Register
F34T12	Nominally 34W T12 4-foot medium bipin lamp
F40T12	Nominally 40W T12 4-foot medium bipin lamp
F96T12	Nominally 75W T12 8-foot single pin slimline lamp
F96T12/ES	Nominally 60W T12 8-foot single pin slimline lamp
F96T12HO	Nominally 110W T12 8-foot recessed double contact high output lamp
F96T12HO/ES	Nominally 95W T12 8-foot recessed double contact high output lamp
GRIM	Government Regulatory Impact Model
Hg	mercury
HVAC	heating, ventilating, and air-conditioning
IESNA	Illuminating Engineering Society of North America
LCC	life-cycle cost
LMC	Lighting Market Characterization
MECS	Manufacturer Energy Consumption Survey
MIA	manufacturer impact analysis
NAECA 1988	National Appliance Energy Conservation Amendments of 1988
NEMS	National Energy Modeling System
NES	national energy savings
NOPR	notice of proposed rulemaking
NO_x	nitrogen oxides
NPV	net present value
OMB	U.S. Office of Management and Budget
PBP	payback period
SO_2	sulfur dioxide
TSD	technical support document

T5, T8, T12	tubular fluorescent lamps, diameters of 5/8, 1, or 1.5 inches, respectively
U.S.C.	United States Code
W	watt

Rulemaking Framework Document for Fluorescent Lamp Ballasts

1 INTRODUCTION

The U.S. Department of Energy (DOE) Appliances and Commercial Equipment Standards Program, within the Office of Energy Efficiency and Renewable Energy's Building Technologies Program (BT), develops and promulgates test procedures and energy conservation standards for consumer appliances and commercial equipment. As a general matter, the process for developing standards involves analysis, public notice, and consultation with interested parties. Such parties, collectively referred to as "stakeholders," include manufacturers, consumers, energy conservation and environmental advocates, State and Federal agencies, and any other groups or individuals with an interest in these standards and test procedures. A DOE Report to Congress[1] submitted on January 31, 2006, identifies the rulemakings DOE has scheduled for completion by June 2011 and explains many of the techniques DOE will be applying during the rulemaking process to meet this schedule.

The purpose of this document is to describe the procedural and analytical approaches DOE anticipates using to evaluate energy conservation standards for fluorescent lamp ballasts (*see* section 1.1 below for a discussion of the statutory authority for this rulemaking). This document is intended to inform stakeholders of the process DOE will follow for the standards rulemaking for these ballasts and to encourage and facilitate stakeholder input during the rulemaking. It should be noted that this document is merely the starting point for developing standards and is not a definitive statement with respect to any issue to be determined in the rulemaking.

Section 1 of this report provides an overview of DOE's rulemaking process. Sections 2 through 16 discuss analyses DOE intends to conduct to fulfill the statutory requirements and guidance for this particular standards rulemaking. As an initial matter, it should be noted that the category "fluorescent lamp ballasts" includes several distinct types of ballasts. DOE will conduct separate analyses for each ballast type to determine whether amended energy conservation standards are technologically feasible, economically justified, and would result in significant energy savings. DOE will maintain information regarding this rulemaking on its website at:
http://www.eere.energy.gov/buildings/appliance_standards/residential/fluorescent_lamp_ballasts.html.

While DOE invites comment on all aspects of the material presented in this document, several specific issues on which DOE seeks comment are set out in comment boxes like this one. DOE uses these comment boxes to highlight issues and ask specific questions on the approaches DOE is proposing to follow to conduct the analyses required for the standards rulemaking. Such requests for feedback are numbered sequentially throughout the document and are repeated in Appendix E.

[1] *Energy Conservation Standards Activities; Submitted Pursuant to Section 141 of the Energy Policy Act of 2005 and to the Conference Report (109-275) to the FY 2006 Energy and Water Development Appropriations Act;* U.S. Department of Energy (Jan. 31, 2006). Available at:
http://www.eere.energy.gov/buildings/appliance_standards/pdfs/congressional_report_013106.pdf.

1.1 The Appliances and Commercial Equipment Standards Program

The Energy Policy and Conservation Act (EPCA) of 1975, Pub. L. 94-163, (42 U.S.C. 6291–6309) established an energy conservation program for major household appliances. Additional amendments to EPCA have given DOE the authority to regulate the energy efficiency of several products, including certain fluorescent lamp ballasts — the products that are the focus of this document. Amendments to EPCA in the National Appliance Energy Conservation Amendments of 1988 (NAECA 1988), Pub. L.100-357, established energy conservation standards for fluorescent lamp ballasts.[2] (42 U.S.C. 6295(g)(5)) A table of the standards promulgated by NAECA 1988 can be found in Appendix A of this document. These same amendments also required that DOE: (1) conduct two rulemaking cycles to determine whether these standards should be amended; and (2) for each rulemaking cycle, determine whether the standards in effect for fluorescent lamp ballasts should be amended so that they would be applicable to additional fluorescent lamp ballasts. (42 U.S.C. 6295(g)(7)(A)-(B))

On September 19, 2000, DOE published a final rule in the *Federal Register* which completed the first of the two rulemaking cycles to evaluate and amend the energy conservation standards for fluorescent lamp ballasts (hereafter "the 2000 Ballast Rule"). 65 FR 56740. This rulemaking established a consensus standard, representing an agreement between the fluorescent lamp ballast industry and energy-efficiency advocacy organizations. The standard levels adopted replaced the ballast efficacy factors that were promulgated in NAECA 1988 for certain fluorescent lamp ballasts. The standard level adopted was intended to eliminate certain so-called "magnetic" ballasts which operate lamps at line frequency (60 Hertz) and are less efficient than "electronic" ballasts, which operate lamps at high frequency.[3] A table of the standards codified by DOE can be found in Appendix A under 10 CFR 430.32(m)(3).

It was later realized that due to the structure of the language in the consensus standard adopted by DOE in the 2000 Ballast Rule, it would still be possible for manufacturers to produce and sell magnetic ballasts for certain types of fluorescent lamps. Aware of this problem, Congress took action on this issue, and promulgated new energy conservation standards for certain fluorescent lamp ballasts under the Energy Policy Act of 2005 (EPACT 2005), Pub. L. 109-58. (EPACT section 135(c)(2); codified at 42 U.S.C. 6295(g)(8)(A)) On October 18, 2005, DOE published a final rule in the *Federal Register* codifying those new fluorescent lamp ballast standards into the Code of Federal Regulations (CFR) at 10 CFR 430.32(m). 70 FR 60407.

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[2] Although fluorescent lamp ballasts are typically understood to be a product used in the commercial and industrial sectors, it is the "consumer products" section of the statute which grants authority to DOE to cover and regulate this product. In the United States Code, Title 42 "The Public Health and Welfare," Chapter 77 "Energy Conservation," Subchapter III "Improving Energy Efficiency," there are two parts which cluster together the group of products which DOE regulates. First, there is "Part A – Energy Conservation Program for Consumer Products Other than Automobiles" which includes a range of consumer products, some which may be classified as being used primarily in the residential sector, such as refrigerators, dishwashers and clothes washers. However, Part A also includes consumer products that might also be used primarily in the commercial sector, such as fluorescent lamps, fluorescent lamp ballasts and urinals. Second, Subchapter III has "Part A-1 – Certain Industrial Equipment," which includes products that are primarily used in the commercial and industrial sectors, such as electric motors and pumps, and packaged terminal air conditioners and heat pumps.

[3] The standard level was intended to eliminate magnetic ballasts that operate one and two nominally 40 watt (W) medium bipin lamps (F40T12) and for ballasts that operate two nominally 75W 8-foot T12 single pin slimline lamps (F96T12).

These standards established minimum ballast efficacy requirements for "energy saver" versions of full-wattage ballasts, such as the F34T12 ballast. A table of the standards promulgated by EPACT 2005 can be found in Appendix A under 10 CFR 430.32(m)(5).

In summary, fluorescent lamp ballasts that are currently regulated under EPCA, as amended, include fluorescent lamp ballasts that are designed to operate one and two nominally 40 watt (W) and 34W 4-foot T12 medium bipin lamps (F40T12 and F34T12), two nominally 75W and 60W 8-foot T12 single pin slimline lamps (F96T12 and F96T12/ES), and two nominally 110W and 95W 8-foot T12 recessed double contact high output lamps (F96T12 and F96T12/ES) at nominal input voltages of 120 or 277 volts with an input current frequency of 60 hertz. 10 CFR 430.32(m). Ballasts that are excluded from regulation include: (1) ballasts designed for dimming to 50 percent or less of its maximum output; (2) ballasts designed for use with two F96T12HO lamps at ambient temperatures of -20 degrees Fahrenheit (°F) or less and for use in an outdoor sign or ballasts designed for use with two F96T12HO/ES lamps at ambient temperatures of 20°F or less and for use in an outdoor sign;[4] (3) ballasts with a power factor of less than 0.90 and designed and labeled for use only in residential building applications; and (4) replacement ballasts as defined in paragraph (m)(4)(ii).[5] 10 CFR 430.32(m)(2), (m)(4), and (m)(7).

On December 19, 2007, the President signed the Energy Independence and Security Act of 2007 (EISA 2007) (Pub. L. 110-140) which makes numerous amendments to EPCA and directs DOE to undertake several new rulemakings for appliance energy efficiency standards. EISA 2007 did not amend standards for fluorescent lamp ballasts, but instead directs DOE to consider standby mode and off mode energy use for these ballasts. More specifically, EISA 2007 directs DOE to amend its test procedure for fluorescent lamp ballasts to incorporate a measure of standby mode and off mode energy consumption by March 31, 2009. (42 U.S.C. 6295(gg)(2)(B)(ii)) In addition, pursuant to 42 U.S.C. 6295(o), DOE is directed to incorporate standby mode and off mode energy use in any amended (or new) standard adopted after July 1, 2010. Because this energy conservation standards rulemaking for fluorescent lamp ballasts will be completed in 2011, the requirement to incorporate standby mode energy use into the energy conservation standards analysis is applicable.

At this time, DOE is studying the standby mode and off mode energy use provisions from EISA 2007 that apply to fluorescent lamp ballasts that are (or could be) covered by this rulemaking. DOE understands that standby mode and off mode energy use, as defined in EISA

[4] Note that in 10 CFR 430.32(m)(7), the temperature exemption granted under EPACT 2005 is slightly different than that contained in sections (m)(2) and (m)(4). In subsection (m)(7), ballasts designed for use with two F96T12HO/ES lamps at ambient temperatures "of 20 degrees F or less" and designated for use in an outdoor sign are exempt from the standards in paragraph (m)(5). The other sections require the ballast to be for ambient temperatures of *negative* 20 degrees F or less.

[5] The exclusion provided for replacement ballasts requires that they meet certain criteria in order to be considered a replacement ballast, such as being designed to replace an existing ballast in a previously installed luminaire and being marked "FOR REPLACEMENT USE ONLY." This exclusion only applies to replacement ballasts manufactured on or before June 30, 2010. After that date, replacement ballasts will no longer be excluded. (10 CFR 430.32(m)(4)(ii)(A)) See Appendix A for the exact language of the exclusion for replacement ballasts.

2007[6], is nonexistent for typical ballasts that operate on a switch or a motion sensor. Fluorescent lamp ballast never meet the definition of "off mode." When a fluorescent lamp ballast is not providing any standby or active mode function (*i.e.*, meeting part II of the definition of "off mode"), the fluorescent lamp ballast must be entirely disconnected from the main power source (*i.e.*, not meeting part I of the definition of "off mode.") In addition, fluorescent lamp ballasts typically do not have a standby mode in which the ballast offers a secondary user-oriented or protective feature while not providing its main function of driving a fluorescent lamp to emit light. DOE understands that it may be possible for a dimming ballast to operate in a zero-light-output standby mode. However, dimming ballasts that dim below 50 percent of rated light output are exempted from the standards. Finally, DOE understands that new ballasts are now being designed with circuitry that adds new features, including intelligent operation. One example of these new ballast designs is a DALI[7]-enabled ballast. DALI-enabled ballasts may have standby power, as they have internal circuitry that is integral to the design of the ballast that remains on and active, even when the ballast is not driving any lamps. DOE is continuing to study DALI-enabled ballasts, as well as other types of fluorescent lamp ballasts to evaluate the issue of standby mode energy use. At the end of this section, DOE invites stakeholder comment on this issue of standby mode and off mode energy use, as it relates to both the test procedure and the energy conservation standards rulemaking for fluorescent lamp ballasts.

In section 324 of EISA 2007, "Metal Halide Lamp Fixtures," several definitions are provided, including "ballast" and "electronic ballast," which although they appear in the section pertaining to standards for Metal Halide Lamp Fixtures, are written in such a way that they also apply to fluorescent lamp ballasts:

> *"Ballast. The term `ballast' means a device used with an electric discharge lamp to obtain necessary circuit conditions (voltage, current, and waveform) for starting and operating." (42 U.S.C. 6291(58))*
>
> *"Electronic Ballast. The term `electronic ballast' means a device that uses semiconductors as the primary means to control lamp starting and operation." (42 U.S.C. 6291(60))*

In addition, section 324 of EISA 2007 establishes new energy efficiency standards for ballasts that operate in metal halide lamp fixtures. Although these new definitions and requirements do not affect the analysis DOE intends to conduct on fluorescent lamp ballasts, DOE provides the language from Section 324 in Appendix D of this Framework Document to facilitate stakeholder review of the provisions pertaining to the definitions of "ballast" and "electronic ballast," as well

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[6] In amending 42 U.S.C. 6295(gg)(1)(a)(i), (ii), and (iii), section 310 of EISA 2007 defines "active mode," "off mode," and "standby mode" as follows: " The term 'active mode' means the condition in which an energy-using product—(I) is connected to a main power source; (II) has been activated; and (III) provides 1 or more main functions." "The term 'off mode' means the condition in which an energy-using product— (I) is connected to a main power source; and (II) is not providing any stand-by or active mode function." "The term 'standby mode' means the condition in which an energy-using product-- (I) is connected to a main power source; and (II) offers 1 or more of the following user-oriented or protective functions: (aa) To facilitate the activation or deactivation of other functions (including active mode) by remote switch (including remote control), internal sensor, or timer. (bb) Continuous functions including information or status displays (including clocks) or sensor-based functions."

[7] DALI stands for the "Digital Addressable Lighting Interface," and it represents a system that enables communication between a central lighting controls system and the individual components, including the ballasts.

as the new ballast efficiency requirements for metal halide lamp fixtures. DOE is aware that some of the same manufacturers produce both fluorescent lamp ballasts and metal halide lamp fixture ballasts.

The above discussion summarizes the pertinent legislative and regulatory history for fluorescent lamp ballasts, and it sets the stage for the issues raised in the balance of this Framework Document, through which DOE is initiating its second cycle to review and to consider amendments to the energy conservation standards in effect for fluorescent lamp ballasts under section 325(g)(7)(B) of EPCA, reproduced below in its entirety:

> *(B) After January 1, 1992, the Secretary shall publish a final rule no later than five years after the date of publication of a previous final rule. The Secretary shall determine in such rule whether to amend the standards in effect for fluorescent lamp ballasts, including whether such standards should be amended so that they would be applicable to additional fluorescent lamp ballasts.*

(42 U.S.C. 6295(g)(7)(B))

This rulemaking will encompass DOE's second cycle of review to determine whether the standards in effect for fluorescent lamp ballasts should be amended, which also fulfills the corollary statutory requirement for DOE to determine whether the standards should be made applicable to additional fluorescent lamp ballasts. This consideration regarding the application of standards to additional fluorescent lamp ballasts is discussed in detail in the following section.

1.2 Overview of Definition and Sub-categories of Covered Fluorescent Lamp Ballasts

As stated in Section 1.1, EPCA directs DOE to determine whether current energy conservation standards for fluorescent lamp ballasts should be made applicable to additional fluorescent lamp ballasts. (42 U.S.C. 6295(g)(7)(B)) DOE is interpreting this directive as a preliminary determination regarding expanded coverage to additional fluorescent lamp ballasts. In other words, DOE will be determining whether an expansion of coverage to certain fluorescent lamp ballasts is appropriate, and will solicit comment on that potential expansion. This approach will provide stakeholders with several opportunities to review and comment on DOE's findings and analyses regarding which additional fluorescent lamp ballasts should be evaluated as potential candidates for coverage and standards.

In the context of this rulemaking, DOE is raising the issue of the expansion of scope in this Framework Document, to inform stakeholders of DOE's intent to evaluate an expansion of coverage and to request comment at this early stage in the rulemaking. In the ANOPR, DOE will present its preliminary findings and rationale for potential expansion of coverage. In deciding whether to establish energy conservation standards for additional ballasts, DOE will use potential energy savings as its primary criteria. DOE will also consider technological feasibility and economic justification as other factors in its evaluation. After identifying additional ballasts for consideration, DOE will then conduct a preliminary assessment on whether a standard for these ballasts would be technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) Following publication of the ANOPR, stakeholders will have an opportunity to comment on DOE's analysis and initial position. Next, in the NOPR stage of the rulemaking,

DOE will present an analysis of comments on the ANOPR related to the expansion of coverage, and then stakeholders will again have an opportunity to comment on DOE's proposal. In the final rule, DOE will publish its determination regarding the expansion of scope for fluorescent lamp ballasts and, if appropriate, set standards under the authority of 42 U.S.C. 6295(g)(7)(B).

In seeking to implement the statutory directive to consider standards for additional fluorescent lamp ballasts, DOE notes that there are currently a wide variety of fluorescent lamp ballasts that are not covered by existing energy conservation standards. Accordingly, these fluorescent lamp ballasts lamps are potential candidates for expanded coverage pursuant to 42 U.S.C. 6295(g)(7)(B).

According to the definition set forth in 42 U.S.C. 6291(29)(A), "[t]he term 'fluorescent lamp ballast' means a device which is used to start and operate fluorescent lamps by providing a starting voltage and current and limiting the current during normal operation." In determining which fluorescent lamp ballasts would be suitable for consideration under 42 U.S.C. 6295(g)(7)(B), DOE intends to focus its inquiry on those ballasts which operate fluorescent lamps with generic physical and operational features closely matching the Illuminating Engineering Society of North America's (IESNA) widely accepted definition of "fluorescent lamp," as contained in "The IESNA Lighting Handbook: Reference and Application," Ninth Edition, 2000, p. G-14:

> *The definition of a fluorescent lamp is "a low-pressure mercury electric-discharge lamp in which a fluorescing coating (phosphor) transforms some of the UV energy generated by the discharge into light."*

This IESNA definition closely matches the general description of a "fluorescent lamp" in the introductory language of 42 U.S.C. 6291(30)(A).[8] Because only lamps with these features are commonly understood to be fluorescent lamps, DOE would only consider standards for ballasts which operate such fluorescent lamps. Therefore, in considering whether to amend the standards in effect for fluorescent lamp ballasts to apply to "additional" fluorescent lamp ballasts under section 325(g)(7)(B) of EPCA, DOE will consider all fluorescent lamp ballasts (for which EPCA does not prescribe standards) that operate fluorescent lamps, as defined by IESNA.

Like the fluorescent lamp market, the fluorescent lamp ballast market has diversified since standards were first established for these covered products under EPCA.[9] Currently, 4-foot T8 medium bipin fluorescent lamp shipments are increasing, whereas 4-foot T12 medium bipin fluorescent lamp shipments (F40T12 or F34T12 lamps) are decreasing, because 4-foot T12 ballasts are being replaced by 4-foot T8 ballasts. In 2004, shipments of 4-foot T8 lamps

[8] The introductory language of 42 U.S.C. 6291(30)(A) is as follows: "the term 'fluorescent lamp' means a low pressure mercury electric-discharge source in which a fluorescing coating transforms some of the ultraviolet energy generated by the mercury discharge into light."

[9] Fluorescent lamp diameters are specified in the lighting industry by the letter "T," which designates a tubular shape, and a numerical value corresponding to a measurement in eighths of an inch. Thus, industry nomenclature would refer to"T8" lamps as tubular fluorescent lamps having a diameter of one inch. Similarly, "T12" lamps are fluorescent lamps with a diameter of one and a half inches.

exceeded those of 4-foot T12 shipments.[10] The increase in 4-foot T8 lamp shipments will most likely be compounded in 2010 when new energy conservation standards for fluorescent lamp ballasts, including replacement F40T12 ballasts and new F34T12 ballasts, go into effect. (*See* 10 CFR 430.32(m)(4)(ii) and (5)-(6)) Eight-foot T8 single pin slimline lamps and 8-foot T8 recessed double contact high output lamps are also replacing their 8-foot T12 counterparts. DOE is considering expanding its coverage to include ballasts that operate T8 lamps because of the potential for significant energy savings. In addition, DOE may also expand its coverage to include ballasts that operate one- and three-lamp 4-foot T12 medium bipin lamps, one-lamp 8-foot T12 single pin slimline lamps, one-lamp 8-foot T12 recessed double contact high output lamps, and 2-foot U-shaped lamps. A detailed initial consideration of scope, including the rationale for coverage for individual ballasts, will be published with DOE's fluorescent lamp ballast ANOPR. At this time, DOE is inviting comment on its planned expansion of scope for fluorescent lamp ballasts.

Item 1 *DOE welcomes comment on the scope of this rulemaking, which implements the statutory requirement to consider additional fluorescent lamp ballasts. (42 U.S.C. 6295(g)(7)(B))*

Item 2 *DOE welcomes comment on the standby power provisions from EISA 2007 and issues arising therefrom, including: (a) How DOE should modify its test procedure for fluorescent lamp ballasts; (b) Which covered fluorescent lamp ballasts are subject to standby mode and off mode energy use?; and (c) How DOE should take standby mode and off mode energy consumption into its analysis for the energy conservation standard?*

1.3 Overview of the Rulemaking Process

1.3.1 Test Procedures

Under 42 U.S.C. 6293(b)(5), the statute directs DOE to establish test procedures for fluorescent lamp ballasts that are in accord with ANSI C82.2-1984, "For Fluorescent Lamp Ballasts- Methods of Measurement," or other test procedures determined appropriate by the Secretary. The 1984 version of C82.2 internally references testing methods for magnetic ballasts (ANSI C82.1-1977, "For Lamp Ballast- Line Frequency Fluorescent Lamp Ballast"), but it does not reference testing methods for electronic ballasts because the testing methods for electronic ballasts were not yet developed in 1984. Because the market is moving towards electronic ballasts,[11] DOE believes it may be necessary to update the test procedures for fluorescent lamp ballasts to the current industry standards, which would include electronic ballasts. At the same time, DOE could also update its test procedure to include more recent testing methods for magnetic ballasts. DOE may incorporate all of the following ANSI test procedures by reference

[10] National Electrical Manufacturers Association. DOE Docket Number EE-2006-STD-0131, filing number 12, p.7 (Sept. 2006).

[11] As described in Section 1.2, T8 lamps (mostly operated by electronic ballasts) are gaining market share, whereas T12 lamps (mostly operated by magnetic ballasts) are losing market share.

in DOE's test procedure rule for fluorescent lamp ballasts: ANSI C82.2-2002, "For Lamp Ballasts- Method of Measurement of Fluorescent Lamp Ballasts," ANSI C82.1-2004, "For Lamp Ballast- Line Frequency Fluorescent Lamp Ballast," and ANSI C82.11-2002, "For Lamp Ballasts- High Frequency Fluorescent Lamp Ballasts." ANSI C82.2 and ANSI C82.1 are test procedures for magnetic ballasts while ANSI C82.11 is a test procedure for electronic ballasts. If these ANSI test procedures are updated during the course of this rulemaking, DOE will consider updated versions in its test procedure rulemaking.

Item 3 *DOE welcomes comment on the issue of updating its fluorescent lamp ballast test procedure. DOE also invites comment on whether it should update the test procedure to include the industry standards ANSI C82.2-2002, C82.1-2004, C82.11-2002 or any additional procedures that should be considered in its test procedure rulemaking for fluorescent lamp ballasts.*

In its comparative review of ANSI C82.2-1984 and C82.2-2002, DOE observed a difference in the methodology ANSI employs to determine the ballast factor (BF) for rapid-start and instant-start ballasts. In the latter version of the ANSI standards, the method used for rapid-start ballasts involves measuring the light output of the lamp operated by the ballast, and calculating the BF[12] from these test results. This approach is consistent with DOE's current test procedure for fluorescent lamp ballasts.[13] For instant-start ballasts however, ANSI calculates the BF using the power delivered to the lamp, rather than the light output of test lamps connected to the ballast. DOE is uncertain how comparable these two test methods are (*i.e.*, whether the more recent ANSI test procedure would alter the measure of energy efficiency (*i.e.*, ballast efficacy factor (BEF)) as compared to the DOE test procedure), and, therefore, is seeking comment on the two ANSI approaches for determining ballast factor for rapid-start and instant-start ballasts. If the methods are not comparable, DOE would be interested in understanding if there are any conversion or adjustment factors that may be used to make the ballast factors between rapid-start and instant-start equipment comparable.

Furthermore, DOE is interested in understanding how BF is calculated for programmed-start ballasts, as well as other types of fluorescent lamp ballasts such as modified-rapid-start ballasts. Should any of the modifications to the test procedure cause a change in how the BEF is calculated, those changes to the test procedure would only become effective on the date that any amended energy conservation standards take effect.

[12] The "ballast factor" (BF) of a rapid-start ballast is the ratio of the light output of a fluorescent lamp or lamps operated on a ballast to the light output of the lamp(s) operated on a standard (reference) ballast. The light output of a single fluorescent lamp is measured on a ballast with a BF of 1.0. The light output of a lamp can be increased or decreased by operating a given lamp on a ballast with a higher or lower BF, respectively.

[13] The measure of energy efficiency of a fluorescent lamp ballast (*i.e.*, ballast efficacy factor (BEF)) is calculated in DOE's test procedure by taking the relative light output of a ballast (*i.e.*, BF for rapid start lamps multiplied by 100) divided by the input power of that ballast. 10 CFR Part 430, Subpart B, Appendix Q, 4.2 (b). A ballast that maintains BF while reducing power consumption will have a higher BEF, and therefore would be considered a more energy-efficient ballast. The energy conservation standards for fluorescent lamp ballasts are prescribed in terms of BEF.

Item 4 *DOE welcomes comment on the two different ANSI methods used to calculate ballast factor for rapid-start and instant-start ballasts. If the two methods are not comparable, DOE invites comment on any conversion factors necessary to make them comparable. Finally, DOE invites comment on whether manufacturers report the ballast factor for instant-start ballasts in their literature using the ANSI or DOE test procedure.*

Item 5 *DOE also welcomes comment on BF calculation methods used for programmed-start ballasts, modified-rapid-start ballasts, and other types of fluorescent lamp ballasts not covered by the DOE test procedure or ANSI C82.2-2002.*

1.3.2 Rulemaking Process and Stakeholder Participation

When DOE evaluates any new or amended energy conservation standard for "covered products" under EPCA, the statute, as amended, specifies that any standard DOE prescribes for consumer products shall be designed to "achieve the maximum improvement in energy efficiency. . . which the Secretary [of Energy] determines is technologically feasible and economically justified." (42 U.S.C. 6295(o)(2)(A)) Moreover, EPCA states that the Secretary may not establish an amended standard if such standard would not result in "significant conservation of energy," or "is not technologically feasible or economically justified." (42 U.S.C. 6295(o)(3)(B)) In determining whether a standard is economically justified, DOE considers, to the greatest extent practicable, the following seven factors:

(1) The economic impact of the standard on the manufacturers and on the consumers of the products subject to such standard;
(2) The savings in operating costs throughout the estimated average life of the covered products in the type (or class) compared to any increase in the price, or in the initial charges for, or maintenance expenses of the covered products which are likely to result from the imposition of the standard;
(3) The total projected amount of energy (or as applicable, water) savings likely to result directly from the imposition of the standard;
(4) Any lessening of the utility or the performance of the covered products likely to result from the imposition of the standard;
(5) The impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from the imposition of the standard;
(6) The need for national energy and water conservation; and
(7) Other factors the Secretary considers relevant.

(42 U.S.C. 6295(o)(2)(B)(i))

Additional statutory requirements for prescribing new or amended standards are set forth in 42 U.S.C. 6295(o)(1)–(2)(A), (2)(B)(ii)-(iii), and (3)–(5).

The process for developing efficiency standards involves analysis, public notice, and consultation with interested parties. Such parties (collectively referred to as stakeholders)

generally include manufacturers, consumers, energy conservation and environmental advocates, State and Federal agencies, and any other groups or individuals with an interest in energy conservation standards and test procedures. DOE considers stakeholder participation to be a very important part of the rulemaking process. Accordingly, DOE actively encourages the participation and interaction of all stakeholders during the comment period provided at each stage of the rulemaking. The broad array of stakeholders who routinely provide comments promotes a balanced discussion of critical information required to conduct the standards rulemaking, beginning with public comment on the Framework Document.

In conducting the test procedure rulemakings and the energy (and water) conservation standards rulemakings, DOE involves stakeholders through a variety of means, including formal public notifications (*i.e.*, *Federal Register* notices) and public meetings. As discussed in further detail below, the standards rulemaking process involves three major public notices, which are published in the *Federal Register*:

- Advance notice of proposed rulemaking (ANOPR, *see* section 1.4). The ANOPR is designed to publicly vet the models and tools that DOE will use in the rulemaking, and to facilitate public participation before the proposed rule stage. Candidate standard levels, which span the range of efficiencies from baseline products to the most efficient technology, are the basis for demonstrating the functionality of the models and tools.

- Notice of proposed rulemaking (NOPR, *see* section 1.5). The NOPR presents: a discussion of comments received in response to the ANOPR; the analysis of the impacts of standards on consumers, manufacturers, and the nation; DOE's weighting of the impacts; and the proposed standard levels for public comment.

- Final rule (*see* section 1.6). The final rule presents a discussion of comments received in response to the NOPR, the revised analysis of the impacts of standards, DOE's weighting of the impacts, and the standard levels DOE is adopting. The final rule also establishes the effective date of the standards.

DOE's January 31, 2006 Report to Congress presents the five-year rulemaking schedule for the codes and standards program. Schedules for a broad set of rulemakings are laid out in the report, including both new rulemakings from EPACT 2005 and "back-log" rulemakings from prior EPCA amendments which DOE is in the process of addressing. The fluorescent lamp ballast rulemaking is considered a "back-log" rulemaking. In the Report to Congress, DOE selected certain energy conservation standards rulemakings as priority rulemakings and others as so-called "valley-fill" rulemakings. Valley-filling is a management technique DOE is imposing on itself to reduce the overall time necessary to complete a rulemaking. In essence, DOE assigns two energy conservation standards rulemakings to one rulemaking team, a normal rulemaking and a valley-fill rulemaking. In this way, when the analytical team is awaiting input on its analysis pertaining to its current priority rule, it will re-direct its efforts to the valley-fill rule. By having overlapping schedules for these two concurrent rulemakings, the average time necessary to complete each of the two final rules is reduced overall, from 36 months each to 31.5 months each.

Valley-fill rulemakings typically publish their ANOPR approximately two years after publication of the Framework Document, whereas priority rulemakings typically publish the ANOPR one and a half years after publication of the Framework Document. DOE has prepared and intends to follow the schedule below for the fluorescent lamp ballast rulemaking.

Table 1.1 Rulemaking Schedule for Fluorescent Lamp Ballast Energy Conservation Standard

Rulemaking Notice	Publication Date
Framework Document	January 2008
ANOPR	November 2009
NOPR	October 2010
Final Rule	June 2011

The fluorescent lamp ballast energy conservation standard will be effective three years after the final rule establishing energy conservation standards for fluorescent lamp ballasts (*i.e.* in June 2014)(*see* 42 U.S.C. 6295(g)(7)(C)).

Concerning the fluorescent lamp ballast test procedure rulemaking, if DOE determines that this rulemaking should be reopened and updated, the final rule for the test procedure would be published on or before publication of the NOPR for the fluorescent lamp ballast energy conservation standard, scheduled for October 2010 (*see* Table 1.1).

1.4 Advance Notice of Proposed Rulemaking

As part of its initial rulemaking activity, DOE typically conducts a screening analysis in which product technology options are identified and subjected to a preliminary determination as to whether DOE will retain that option for detailed analysis or to eliminate it from further consideration. This process includes a market and technology assessment (*see* section 3) and a screening analysis (*see* section 4). DOE applies four screening criteria in the screening analysis to determine which technology options to eliminate from further consideration. These four criteria are: (1) technological feasibility; (2) practicability to manufacture, install, and service; (3) adverse impacts on product utility or availability; and (4) adverse impacts on health or safety. Technologies that pass through the screening analysis are referred to as "design options" in the engineering analysis.

These activities include consultations with stakeholders and independent technical experts who can assist with identifying the key issues and design options or efficiency levels that DOE will consider in the rulemaking. DOE intends this Framework Document, the public meeting following its publication, and the opportunity for comment on this Framework Document to initiate dialogue with stakeholders, and to provide an opportunity for comment and input into the structure and analytical approach planned for this energy conservation standards rulemaking.

At the start of the ANOPR analysis, DOE considers design options or efficiency levels for each product class. DOE uses these design options or efficiency levels to collect manufacturer cost data, historical shipment data, shipment-weighted average efficiency data, and preliminary manufacturer impact data (*e.g.*, capital conversion expenditures, marketing costs, research and development costs). During the ANOPR stage of the rulemaking, DOE also conducts other principal analyses, including: (1) the engineering analysis (*see* section 5); (2) the consumer LCC and PBP analysis (*see* section 8); (3) the national impact analysis, which considers national energy savings (NES) and consumer net present value (NPV) (*see* section 10); and (4) a preliminary manufacturer impact analysis (*see* section 12). DOE will present the results of these analyses in the ANOPR *Federal Register* notice.

Discussion of various candidate standard levels (efficiency levels) in the ANOPR will facilitate stakeholder review of the spreadsheet models that underpin the analyses. DOE will use stakeholder comments to refine the models for the next stage of the rulemaking analyses, where DOE will propose specific efficiency levels for adoption. Based on the results of the ANOPR analysis, DOE selects candidate standard levels (CSLs) from the energy efficiency or energy use levels considered in the ANOPR analysis. In addition to the efficiency corresponding to the maximum technologically feasible ("max-tech") design and the efficiency corresponding to the minimum LCC point, DOE generally selects levels or design options for consideration that span the full range of technologically-achievable efficiencies. The range of levels DOE typically analyzes includes:

- The baseline efficiency level (*i.e.*, the minimum level) is defined by the product with the lowest energy efficiency level currently sold on the market for a given category. For product categories where minimum energy efficiency standards already exist, the baseline efficiency level is typically defined by the existing energy conservation standard;

- The highest energy efficiency level or lowest energy consumption level that is technologically feasible (*i.e.,* the "max-tech" level);

- The level with the minimum life-cycle cost (LCC) or greatest LCC savings; and

- Levels that incorporate noteworthy technologies or fill in large gaps between other efficiency levels considered.

The efficiency or energy use levels DOE analyzes serve to demonstrate the functions and outputs of the models and tools. At the ANOPR stage, DOE uses analytical models and tools to assess the different product classes at each efficiency or energy use level analyzed. Many of these analytical models and tools are in the form of spreadsheets, some of which are used to conduct the LCC and PBP analysis, as well as to determine the NES and NPV of prospective standards. In addition, preliminary ANOPR results may facilitate discussions among interested parties on potential joint recommendations for standard levels.

DOE will make the spreadsheet tools and results of the ANOPR analyses available on its website for review and will consider comments on them after publication of the ANOPR.[14] When it publishes the ANOPR, DOE will also make available a Technical Support Document (TSD) containing the details of all the analyses performed to date. After the publication of the ANOPR, DOE will provide a 75-day public comment period and hold one public meeting. At this point, DOE encourages stakeholders, to the extent possible, to develop joint recommendations for standard levels.

1.5 Notice of Proposed Rulemaking

In developing the NOPR, DOE will first review and consider all the comments it received after the publication of the ANOPR. This process may result in revisions or refinements to the ANOPR analyses, including the engineering and LCC analyses. DOE also will conduct additional economic and environmental impact analyses at this stage of the rulemaking. These analyses generally include a consumer LCC subgroup analysis (*see* section 11), a complete manufacturer impact analysis (*see* section 12), a utility impact analysis (*see* section 13), an employment impact analysis (*see* section 14), an environmental assessment (*see* section 15), and a regulatory impact analysis (*see* section 16).

DOE will describe the methodology used and make the results of all the analyses available on its website for review and comments. Based on comments by stakeholders, further revisions to the analysis may be undertaken. This analytical process ends with the selection of proposed standard levels (if any) that DOE will present in the NOPR. DOE selects the proposed standard levels from the trial standard levels (TSLs) analyzed during the NOPR phase of the rulemaking. The NOPR, published in the *Federal Register*, will document the evaluation and selection of any proposed standards levels, along with a discussion of other TSLs considered but not selected (and the reasons for not selecting them).

The selection process for proposed efficiency standards generally runs as follows. For each product class, DOE will identify the max-tech efficiency level. If DOE proposes a level lower than that, it will sequentially explain the reasons for eliminating higher levels, beginning with the highest level considered. DOE will present the analytical results in the NOPR, with the details of the analysis provided in an accompanying TSD.

DOE considers many factors in selecting proposed standards, as described above in section 1.3.2. These factors and criteria are contained in EPCA and take into consideration the benefits, costs, and impacts of energy conservation standards. Additionally, DOE encourages stakeholders to develop joint recommendations for standard levels. DOE will carefully consider such recommendations in its decision process.

When DOE publishes the NOPR, it will provide the Department of Justice (DOJ) with copies of the NOPR and TSD, in order to solicit feedback on the impact of the proposed standard

[14] All materials associated with the fluorescent lamp ballast determination analyses, test procedures, and energy conservation standards are available on DOE's website at: <*http://www.eere.energy.gov/buildings/appliance_standards/residential/fluorescent_lamp_ballasts.html*>

levels on competition in the ballast industry. DOJ will review these standard levels in light of any lessening of competition that is likely to result from the imposition of standards (*see* 42 U.S.C. 6295(o)(2)(B)(i)(V) and (B)(ii)). Publication of the NOPR will be followed by a 75-day public comment period that includes one public meeting.

1.6 Final Rule

After the publication of the NOPR, DOE will consider public comments it receives on the proposal (including TSLs) and accompanying analyses. On the basis of the public comments, DOE will review the engineering and economic impact analyses and proposed standards and consider modifications where necessary. Before the final rule is issued, DOE also will consider DOJ comments on the NOPR relating to the impacts of the proposed standard levels on competition, to determine whether changes to these standard levels are needed.

The standards rulemaking will conclude with the publication of the final rule. DOE will select the final standard level based on the complete record of the standards rulemaking. The final rule will promulgate the final standard level and the effective date and explain the basis for their selection. The final rule will be accompanied by a final TSD.

2 OVERVIEW OF ANALYSES FOR RULEMAKING

The purpose of the analyses conducted in support of the standards rulemaking is to ensure that DOE selects energy conservation standards that achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified, and will result in significant energy savings. Economic justification includes the consideration of economic impacts on domestic manufacturers and consumers, national benefits including environmental impacts, issues of consumer utility, and impacts from any lessening of competition. DOE expects the selection of such standards to achieve the maximum energy savings that are economically justified without imposing excessive financial burden on any particular party.

Figure 1 summarizes the analytical components of the standards-setting process. The "analyses" are presented in the center column. Each analysis has a set of "key inputs," which are data and information required for the analysis. "Approaches" are the methods that DOE will use to obtain key inputs, which may vary depending on the information in question. For example, some key inputs exist in public databases; DOE will collect other information from stakeholders or experts with special knowledge, and DOE will develop yet other information independently in support of this rulemaking. The results of each analysis are "key outputs," which feed directly into the rulemaking. Arrows indicate the flow of information between the various analyses. DOE ensures a consistent approach to its analyses throughout the rulemaking by considering each analysis as a part of the overall standards-setting framework.

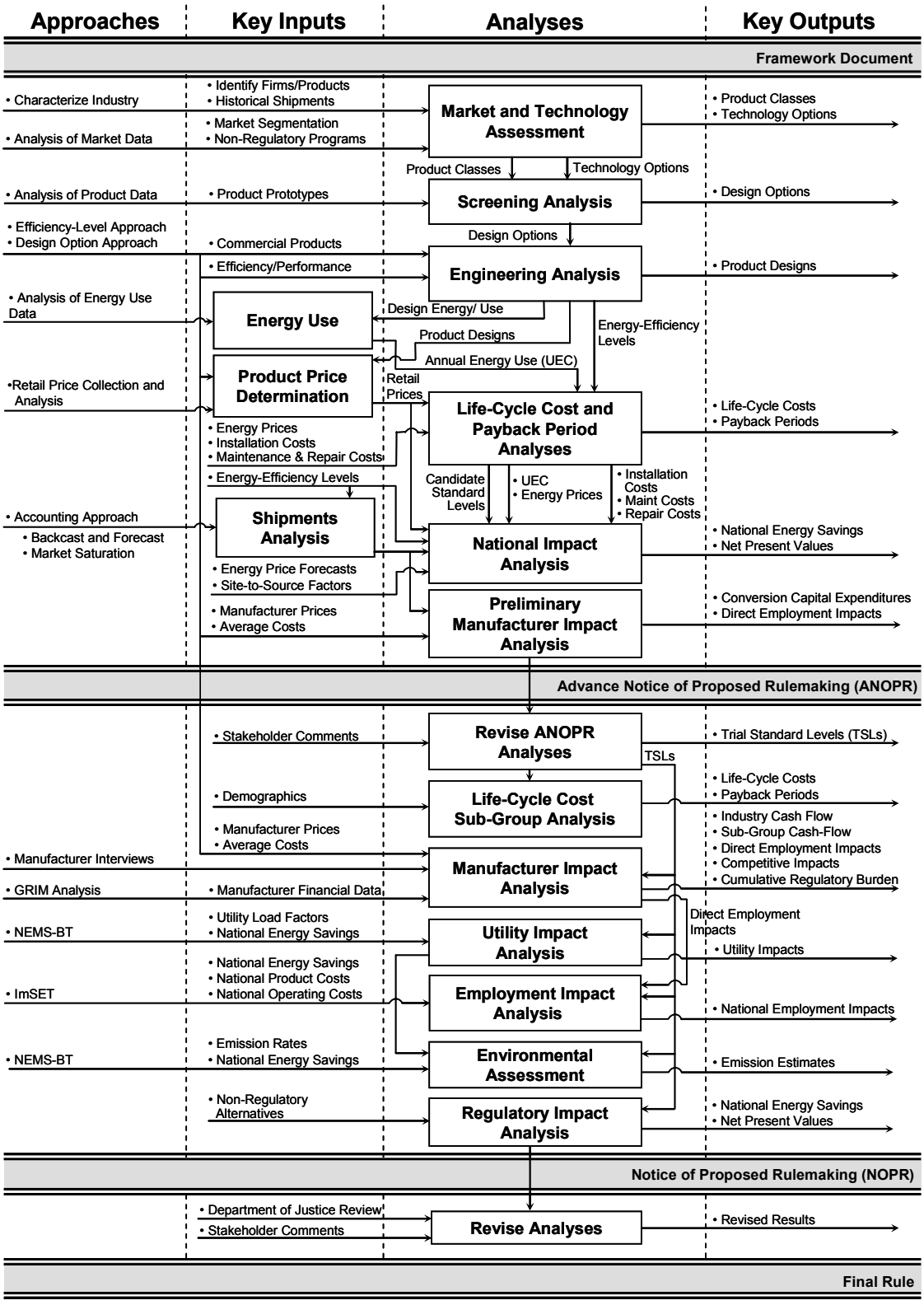

Figure 1 Flow Diagram of Analyses Conducted for an Energy Conservation Standard Rulemaking

3 MARKET AND TECHNOLOGY ASSESSMENT

The market and technology assessment will provide information about the manufacturers of fluorescent lamp ballasts and specifics about the performance attributes of these fluorescent lamp ballasts. This assessment is particularly important at the outset of the rulemaking for developing product classes and for identifying technology options that improve the BEF (*i.e.*, efficiency) of fluorescent lamp ballasts.

3.1 Market Assessment

DOE will qualitatively and quantitatively characterize the structure of the markets for fluorescent lamp ballasts. In the market assessment, DOE will identify and characterize the manufacturers of this equipment, estimate market shares and trends, address regulatory and non-regulatory initiatives intended to improve the efficiency or reduce the energy consumption of covered ballasts, and explore the potential for technological improvements in the design and manufacturing of such equipment.

This market assessment will establish the context for this rulemaking, and it will serve as a resource to guide the analyses that follow. For example, DOE may use historical shipments and prices as an indicator of future shipments and prices. Similarly, DOE plans to use market structure data for the manufacturer impact analysis, data which will be particularly useful for assessing competitive impacts. This phase also allows DOE to start updating design options by reviewing product literature and industry publications.

DOE recognizes that there may be limited public information on national shipments, manufacturing costs, channels of distribution, and manufacturers' market shares of fluorescent lamp ballasts. This type of data is an important input for analyses that determine if energy conservation standards are economically justified and will result in significant energy savings. Therefore, DOE encourages stakeholders to submit data that pertains to these areas of interest and would improve DOE's understanding of the fluorescent lamp ballast market. These data may be provided under a confidentiality agreement with DOE's contractor responsible for this part of the rulemaking analysis, namely Navigant Consulting, Inc. (NCI). In other rulemakings, NCI works with confidential data provided by manufacturers and other organizations, in preparing aggregated results for DOE's analysis. These aggregated results do not divulge the sensitive nature of the individual raw data, but enable other stakeholders to review and comment on the aggregated dataset.

Alternatively, stakeholders may submit confidential data to DOE, indicating in writing which data should remain confidential. In order to prevent public disclosure of the data due to actions taken by a third party, stakeholders providing confidential information to DOE must submit that data according to 10 CFR 1004.11. Under 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit two copies. One copy of the document shall include all the information believed to be confidential, and the other copy of the document shall have the information believed to be

confidential deleted. DOE will make its own determination about the confidential status of the information and treat it according to its determination.[15]

DOE is creating a database of commonly-available products based on recent manufacturer catalogues from fluorescent lamp ballast manufacturers, including both small and large market participants. This database of ballasts will enable DOE to understand what is available in the market and to better assess which ballasts should be considered in the expansion of scope (*see* section 1.2). DOE will use the resulting knowledge about product availability to evaluate how the market may respond to various standard levels (*e.g.*, consumers substituting fluorescent lamp ballasts that are not subject to regulation), and to gain insight on the performance attributes of various commercially-available ballast technologies.

Item 6 *DOE welcomes input on shipments, manufacturing costs, product-feature and efficiency trends, distribution channels, and estimates of market shares for the fluorescent lamp ballasts covered in this rulemaking. For DOE to be able to use the data to conduct energy savings calculations, a degree of disaggregation (e.g., by product class) is desirable.*

In preparation for its review under Executive Order 12866, "Regulatory Planning and Review," DOE will be studying market failures or other specific problems that may warrant agency action. DOE will assess the significance of any problem, to enable assessment of whether a new regulation of fluorescent lamp ballasts is warranted.

DOE believes that there is a lack of consumer information and/or information processing capability about energy efficiency opportunities in the lighting market. Fluorescent lighting systems are composed of ballasts and lamps, and are complex systems with a multitude of varying properties such as ballast factor, ballast efficacy factor, lamp type, wattage and so on. These numerous variables impose high information costs which may prevent purchasers from selecting the most cost-effective fluorescent lighting system.

DOE believes there is also a potential market failure surrounding the problem of asymmetric information (one party to a transaction has more and better information than the other) and/or high transactions costs (costs of gathering information and effecting exchanges of goods and services). In the case of ballasts, in many instances the party responsible for the ballast purchase may not be the one who pays the cost to operate it. Building owners and developers may make purchase decisions about lighting fixtures which include ballasts and lamps, but it may be the tenants who pay the utility bills. Although renters often have the

[15] Factors that DOE considers when evaluating requests to treat submitted information as confidential include: (1) a description of the items; (2) whether and why such items are customarily treated as confidential within the industry; (3) whether the information is generally known by, or available from other public sources; (4) whether the information has previously been made available to others without obligation concerning its confidentiality; (5) an explanation of the competitive injury to the submitting person which would result from public disclosure; (6) a date after which such information might lose its confidential character; and (7) why disclosure of the information would be contrary to the public interest.

opportunity to purchase the replacement lamps, from a practical perspective, they may be constrained in their choices by prior fixture and ballast selections. If there were no transactions costs, it would be in the building developers' and owners' interests to install lighting fixtures selected by the tenants. For example, a tenant who knowingly faces higher utility bills from low-efficiency lighting might expect to pay a lower rent, forcing the building owner to indirectly bear the higher utility cost. However, information about lighting-related utility bills is not costless, and it may not be in the interest of the renter to take the time to develop it, or, in the case of the building owner who installs the lamp system, to convey that information to the renter.

To the extent that asymmetric information and/or high transactions costs are problems, one would expect to find certain outcomes with respect to commercial and industrial lighting energy efficiency. For example, other things equal, one would not expect to see higher rents for office space with high-efficiency lighting systems. Conversely, if there were symmetric information, one would expect higher energy efficiency lighting in commercial space where the rent includes utilities, as compared to those where the tenant pays the utility bills separately.

DOE also believes that there may be certain "external" benefits resulting from the improved efficiency of units that are not captured by the users of such equipment. These include both environmental and energy security-related externalities that are not already reflected in energy prices, such as reduced emissions of greenhouse gases and reduced use of natural gas and oil for electricity generation. DOE invites comments on the weight that should be given to these factors in DOE's determination of the maximum efficiency level at which the total benefits are likely to exceed the total costs resulting from a DOE standard.

DOE is seeking data that would enable it to conduct tests of market failure for products under consideration for standard-setting. For example, given adequate data, there are ways to test for the extent of market failure for commercial ballasts. One would expect the owners of fluorescent lamp ballasts who also pay for their electricity consumption to purchase ballasts that exhibit higher energy efficiency compared to lamps whose owners do not pay for the electricity usage, all else being equal. To test for this form of market failure, DOE needs data on energy efficiency of such units and whether the owner of the equipment is also the one who pays the operating costs. DOE is also interested in other potential tests of market failure and data that would enable such tests.

Item 7 *DOE is seeking stakeholder comment and data on potential market failures that could apply to fluorescent lamp ballasts.*

3.2 Product Classes

When necessary, DOE divides covered product into classes by: (a) the type of energy used; (b) the capacity of the product; or (c) any other performance-related feature that justifies different standard levels, such as features affecting consumer utility. (42 U.S.C. 6295(q)) DOE then conducts its analysis and considers establishing or amending standards so as to provide separate standard levels for each product class.

In amending EPCA, NAECA 1988 established eight product classes for fluorescent lamp ballasts, as shown in Table 3.1.

Table 3.1 EPCA Product Classes established by NAECA 1988 for Fluorescent Lamp Ballasts

Application for Operation of	Ballast Input Voltage	Total Nominal Lamp Watts
One F40T12 lamp	120	40
	277	40
Two F40T12 lamps	120	80
	277	80
Two F96T12 lamps	120	150
	277	150
Two F96T12HO lamps	120	220
	277	220

In further amendments to EPCA, EPACT 2005 established an additional eight product classes for fluorescent lamp ballasts, as shown in Table 3.2.

Table 3.2 EPCA Product Classes established by EPACT 2005 for Fluorescent Lamp Ballasts

Application for Operation of	Ballast Input Voltage	Total Nominal Lamp Watts
One F34T12 lamp	120	34
	277	34
Two F34T12 lamps	120	68
	277	68
Two F96T12/ES lamps	120	120
	277	120
Two F96T12HO/ES lamps	120	190
	277	190

As described above in section 1.2, DOE understands that in addition to the lamps and lamp ballasts identified in Table 3.1 and Table 3.2, the fluorescent lamp ballast market today includes ballasts that operate smaller diameter lamps such as T8 and T5 lamps. These fluorescent lamp and ballast systems are gaining in market share, whereas T12 systems are becoming less popular and consequently, losing market share. This market shift is expected to accelerate in 2010, when the exclusion from the standard levels established by the 2000 Ballast Rule and EPACT 2005 for replacement ballasts will expire. The standard levels (*i.e.*, the BEF) established by the 2000 Ballast Rule and EPACT 2005 for fluorescent lamp ballasts will essentially eliminate magnetic ballasts from the marketplace by requiring a BEF that is not attainable with magnetic ballast technology. Because magnetic ballasts comprise the large majority of T12 ballast sales, DOE believes that when the standards prevent the sales of magnetic T12 ballasts, there will be a further increase in the shipments of high-frequency ballasts that operate T8 and T5 lamps.

Because of these market changes and because DOE is anticipating expanding its scope of covered product for fluorescent lamp ballasts, DOE is considering amending the product classes for fluorescent lamp ballasts. DOE may establish separate product classes for ballasts that operate specific lamp lengths and lamp base types, as well as the number of lamps that the ballast operates. For example, DOE is considering establishing one product class for all ballasts that operate two 4-foot medium bipin lamps, irrespective of lamp diameter. To account for the variance in BEF by lamp wattage in a product class like this, DOE could develop an equation from which manufacturers could calculate the minimum BEF energy conservation standard based on the fluorescent lamps' wattage.

If appropriate, DOE could further divide product classes by the diameter of the lamp operated by the ballast, the starting method of the ballast (*e.g.*, rapid-start, instant-start, programmed-start), and/or the total harmonic distortion of the ballast. If DOE chooses not to establish an equation for the minimum BEF standard that takes into account fluorescent lamp wattage, DOE may choose to subdivide product classes by the wattage of the lamp operated by the ballast. Product classes may also be established for ballasts which have the ability to operate multiple input voltages (*i.e.*, universal or non-universal voltage systems) or the ability of a ballast to operate multiple numbers of lamps (*i.e.*, a 2-lamp ballast that can also operate three lamps versus a 2-lamp ballast that can operate only two lamps). DOE seeks comment on all of the possible approaches described above for product classes, as well as any other methods for establishing product classes corresponding to the requirements of 42 U.S.C. 6295(q), discussed above.

Item 8 *DOE welcomes comment on product classes for fluorescent lamp ballasts and approaches to defining classes in accordance with the requirements of 42 U.S.C. 6295(q).*

3.3 Technology Assessment

The technology assessment centers on understanding how energy is used by the product, and efficiency measures that would work to reduce energy consumption by the fluorescent ballast. These measures that improve the energy efficiency of the product are called "technology options," and they are based on existing technologies, as well as prototype designs and concepts. In consultation with stakeholders, DOE will develop a list of technology options for consideration in this rulemaking. Following research into this list of technology options, DOE will then consider each of them against four screening criteria: (1) technological feasibility; (2) practicability to manufacture, install, and service; (3) adverse impacts on product utility or availability; and (4) adverse impacts on health or safety (*see* section 4 for discussion on the four screening criteria). Those technology options that pass the four screening criteria are called "design options" and will be considered as appropriate ways of improving the efficiency of the product in the engineering analysis and will assist DOE in determining the "max-tech" design.

DOE is studying technology options that could be employed to improve the BEF of the fluorescent lamp ballasts covered in this rulemaking. Accordingly, DOE is reviewing manufacturer catalogues, recent trade publications, technical journals and patent filings. To

gather more information, DOE also intends to consult with technical experts who have worked on fluorescent lamp ballast designs and to conduct manufacturer interviews about these technology options.

Presently, DOE is aware of a limited set of technology options that could improve the efficiency of these ballasts. However, due to provisions in prior DOE standards, certain technology options may only be applied to certain product classes. For example, existing standards do not allow for the sale of magnetic ballasts that operate one F40T12 lamp. 65 FR 56740. Therefore, the cathode cutout technology option, which can only be used for magnetic ballasts, cannot be incorporated into this product class. However, existing standards for ballasts that operate two F96T12HO lamps allow for magnetic ballast operation, and, therefore, the cathode cutout ballast is a technology option for this product class. 65 FR 56740.

A list of preliminary technology options that DOE intends to study for the ANOPR includes the following:

- Cathode Cutout or Hybrid Ballast. The cathode cutout or hybrid ballast is a magnetic ballast that uses an electronic circuit to remove electrode power after the discharge has been initiated for rapid-start lamps. Cathode cutout ballasts start lamps in the same way that magnetic rapid-start ballasts do. Operating lamps without electrode power maintains the light output while reducing power by about two watts per lamp.

- The Electronic Ballast. For equivalent light output, electronic ballasts generally consume less energy than magnetic ballasts. The electronic ballast converts the 60 hertz alternating current input power into a high-frequency voltage (20 kilohertz or higher) to operate the lamp. At high frequency, the losses near the lamp electrode are decreased. In addition, high-frequency operation utilizes smaller components, thereby reducing ballast losses and making the ballast more efficient.

- Integrated Circuits. By substituting integrated circuits for discrete components, electronic ballasts can save additional energy through a reduction in conductive energy losses.

- Higher-Grade Components. Higher-grade components can further reduce energy losses in ballasts. For example, using higher-grade magnetic materials in both high-frequency transformers and inductors can increase the efficiency of electronic ballasts. Improved semiconductor materials used in integrated circuits can also improve the efficiency of a fluorescent lamp ballast.

- Improved Circuit Design. Better circuit design may also improve the efficiency of an electronic ballast. For instance, through better circuit design, a ballast's power factor can be increased. The higher a ballast's power factor, the lower the current per watt required to operate the ballast. These decreased currents reduce additional losses in the power distribution system because of lower conductive losses (also called I^2R losses).

Item 9 *DOE welcomes comment on the preliminary technology options identified in this section. DOE welcomes comment on whether there are other technology options that it should consider. In commenting on design options, please discuss their impacts on safety, performance, and consumer utility (if any).*

4 SCREENING ANALYSIS

The purpose of the screening analysis is to screen out technology options that DOE will not consider in the rulemaking for fluorescent lamp ballasts. DOE will follow the process set forth below to screen out technology design options.

As an initial matter, DOE will develop a list of technology options (developed through its own research and in consultation with interested parties) for consideration in the engineering analysis (*see* section 5). The identified candidate technology options or best available technologies will encompass all those technologies that may be technologically feasible. Thereafter, DOE will review each such technology option or best available technology in light of the following four criteria, as provided in sections 4(a)(4) and 5(b) of the Process Rule[16] and tailored to the current rulemaking:

1. *Technological feasibility.* DOE will not further consider technologies that are not incorporated in commercially-available products or in working prototypes.

2. *Practicability to manufacture, install, and service.* If DOE determines that mass production of a technology in commercial products and reliable installation and servicing of the technology could not be achieved on the scale necessary to serve the relevant market by the time of the effective date of the standard, then it will not consider that technology further.

3. *Adverse impacts on product or equipment utility or availability.* If DOE determines a technology to have significant adverse impact on the utility of the product to significant subgroups of consumers, or result in the unavailability of any covered product type with performance characteristics (including reliability), features, size, capacities, and volumes that are substantially the same as products generally available in the United States at the time, it will not consider that technology further.

4. *Adverse impacts on health or safety.* If DOE determines that a technology will have significant adverse impacts on health or safety, it will not consider that technology further.

DOE will fully document its reasons for eliminating any technology options during the screening analysis, and will publish this documentation for stakeholder review and comment as part of the ANOPR. Those technology options which are not screened out by the above four

[16] 10 CFR Part 430, Subpart C, Appendix A.

criteria are called "design options" and are considered in the development of cost-efficiency curves in the engineering analysis.

Item 10 *DOE welcomes comment on how the above four screening criteria might apply to any additional technology design option(s) that a stakeholder recommends to DOE.*

5 ENGINEERING ANALYSIS

After conducting the screening analysis described above, DOE will perform an engineering analysis based on the remaining design options that improve product efficiency. The engineering analysis consists of estimating the energy consumption and cost of products at various levels of increased efficiency. In this chapter, section 5.1 provides an overview of the engineering analysis; section 5.2 discusses baseline models; section 5.3 describes DOE's proposed approach; section 5.4 addresses proprietary designs; and section 5.5 discusses cumulative regulatory burdens that might affect the engineering analysis.

5.1 Engineering Analysis Overview

The purpose of the engineering analysis (discussed in this chapter) and the product price determination (discussed in chapter 7) is to determine the relationship between fluorescent lamp ballast efficiency and end-user price. This combination of the relationship between price and efficiency serves as the basis for cost/benefit calculations to individual consumers in the LCC analysis and to the nation in the NIA.

The engineering analysis will focus on selecting commercially-available ballasts that exhibit design options that improve the BEF. The engineering analysis will also identify the highest efficiency that is technologically feasible within each product class (*i.e.*, the "max-tech" model).

5.2 Baseline Models

Once DOE establishes product classes for fluorescent lamp ballasts, it will need to identify baseline models which will serve as reference points against which it can measure changes resulting from potential energy conservation standards. DOE will develop a separate engineering analysis for each of the baseline models selected.

In order to manage the analytical burden and maintain the schedule for this rulemaking, DOE may need to limit the number of product classes selected for analysis. The selected product classes (called "representative product classes") would be chosen to encompass those ballasts which have the highest volume of market share or some other unique performance characteristic that deserves special consideration. Once it has identified the representative product classes, DOE would select baseline models from those representative product classes, which would be

analyzed in the rulemaking. The results of DOE's analysis would then be scaled from the representative product classes to the other product classes that were not analyzed.

Selection of the baseline model is a critical aspect of DOE's analytical approach. The baseline model should represent the characteristics of common or typical product sold in a given product class. Typically, the baseline model would be a model that just meets current energy conservation standard. If there are not standards that apply to a product, as is the case with the additional fluorescent lamp ballasts that DOE intends to consider in this rulemaking, DOE will select baseline models typical of the least-efficient ballast offered for sale in the market. This baseline model will encompass ballast features and performance characteristics such as power factor, total harmonic distortion, and ballast factor. DOE will not define all the detailed characteristics of the potential baseline models until it receives comments from stakeholders and can conduct further analysis.

In section 3.2, DOE discusses factors that may be used to establish product class divisions for fluorescent lamp ballasts. DOE believes that it may be possible to extrapolate analyses conducted on one product class to another (*e.g.*, extrapolate minimum BEF from ballasts that operate one lamp type to ballasts that operate a different lamp type). DOE is inviting comment on the identification and selection of representative product classes and on a representative ballast or ballasts that may serve as baseline models for those product classes. The representative ballasts selected will be evaluated in both the engineering analysis and LCC analysis (*see* section 8).

As stated above, once the representative analysis on the baseline models is complete, DOE will then scale those findings to the other product classes which were not analyzed. For this reason, the importance of carefully selecting representative product classes is critical, in order to ensure that DOE is extending its findings to product classes appropriately. DOE is inviting comment on fluorescent lamp ballast scaling relationships between ballast product classes.

Item 11 *DOE welcomes comment on representative product classes and selection of baseline models from those representative product classes.*

Item 12 *DOE welcomes comment on the scaling of findings from representative product classes to other product classes that DOE may not analyze.*

5.3 Engineering Analysis Approach

In the engineering analysis, DOE will select a series of more-efficient ballasts (*i.e.*, commercially-available ballasts) for each of the baseline models considered within each representative product class. As stated above, these ballasts will be paired with prices (developed in the product price determination) to develop the relationship between efficiency and price. The relationship between price and efficiency serves as the basis for cost/benefit calculations for individual consumers and the nation.

Selections of these ballasts will be made such that potential substitutions maintain light output within 10 percent from the baseline system's light output, and that the substitute lamp and ballast system have performance characteristics similar to those of the baseline system. In identifying more-efficient substitutes, DOE will utilize a database of commercially-available ballasts. If ballasts that operate T8 and T12 lamps are in the same product class, DOE may consider commercially-available ballasts under two different substitution scenarios: (1) higher-efficiency ballasts which operate the same diameter lamp; and (2) higher-efficiency ballasts which operate a smaller diameter lamp.

Having identified the more-efficacious substitutes for each of the baseline lamp-and-ballast systems, DOE will develop CSLs. CSLs are a set of efficiency levels considered in the ANOPR that spans the range of BEFs from baseline products to the maximum technologically feasible. Each CSL is analyzed in the LCC and NIA analysis. At the NOPR stage of the rulemaking process, DOE will propose an energy conservation standard for public comment.

CSLs for fluorescent lamp ballasts are generally based on the consideration of several factors, including: (1) design options associated with the specific ballasts being studied; (2) the ability of ballasts that operate a given diameter lamp across multiple wattages to comply with the standard level of a given product class;[17] and (3) the maximum technologically-feasible level. DOE welcomes comment from stakeholders on the selection of higher-efficiency ballasts.

Item 13	*DOE welcomes comment on commercially-available fluorescent lamp ballasts for each of the baseline models with incrementally increasing BEF, all the way to the max-tech ballast.*
Item 14	*DOE welcomes comment on how BEF varies with lamp wattage.*

5.4 Proprietary Designs

DOE will consider in its engineering and economic analyses all design options that are commercially available or present in a working prototype, including proprietary designs, that meet the screening criteria discussed in section 4. However, DOE will consider a proprietary design in the subsequent analyses only if it does not represent a unique path to a given efficiency level. If the proprietary design is the only approach available to achieve a given efficiency level, then DOE will reject the efficiency level (that can only be achieved by a proprietary design) from further analysis, because the analytical results would appear to favor one manufacturer over others. However, if a given energy efficiency level can be achieved by a number of design approaches, including with a proprietary design, DOE may examine the given efficiency level based on that design. Furthermore, DOE is sensitive to manufacturer concerns regarding proprietary designs and will take appropriate steps to maintain the confidentiality of any proprietary data provided by manufacturers. This information will provide input to the competitive impacts assessment and other economic analyses.

[17] The BEF of a given ballast will vary depending on the wattage of the lamp it is operating. In selecting CSLs, DOE will consider whether ballasts that operate lamps at multiple wattages will meet a given CSL.

Item 15 *Are there proprietary designs of which DOE should be aware for any of the fluorescent lamp ballasts under consideration in this rulemaking? If so, how DOE should acquire the cost data necessary for evaluating these designs?*

5.5 Outside Regulatory Changes Affecting the Engineering Analysis

In conducting an engineering analysis, DOE takes into consideration the effects of regulatory burdens outside DOE's statutory energy conservation standards rulemaking process that can impact the manufacturers of the covered equipment. Some regulatory requirements can also affect the energy efficiency or energy consumption of the fluorescent lamp ballasts covered under this rulemaking. DOE will attempt to identify all such outside regulatory requirements that could impact the engineering analysis. The consideration of these requirements is closely related to the cumulative regulatory burden assessment that DOE will carry out as part of the manufacturer impact analysis. Based on consideration of the comments received on the engineering analysis documented in the ANOPR, DOE will make the necessary changes to its analysis. It will reflect those changes in the documentation of the NOPR.

Item 16 *DOE welcomes comment on regulatory burdens or changes that should be considered in the engineering analysis of fluorescent lamp ballasts.*

Item 17 *DOE welcomes comment on other engineering issues that could impact the engineering analysis.*

6 ENERGY USE AND END-USE LOAD CHARACTERIZATION

The purpose of the energy-use and end-use load characterization is to identify how products and equipment are used by consumers, and thereby determine the energy savings potential of energy efficiency improvements. For fluorescent lamp ballasts, DOE's analysis will focus on how end users install and operate these ballasts.

The energy-use and end-use load characterization, which is an input to the LCC and national impact analyses, will capture and represent the typical energy consumption in the field. This usage profile will enable DOE to conduct a calculation to determine the LCC and the payback period (PBP) of more efficient ballast technologies relative to the baseline ballast.

For fluorescent lamp ballasts, energy consumption is derived by multiplying the system power rating by the number of operating hours in a given year. The system power rating will be developed in the engineering analysis, as it is a necessary parameter in determining the BEF. DOE is considering using data from the U.S. Lighting Market Characterization: Volume I

(LMC),[18] the Energy Information Administration's (EIA) 2003 Commercial Building Energy Consumption Survey (CBECS),[19] and the 2002 Manufacturer Energy Consumption Survey (MECS)[20] to develop a distribution of operating hours for fluorescent lamps by sector and Census Division. The EIA studies provide information on the distribution of buildings within the U.S., by building type and census division. The LMC, which is based on thousands of building audits and surveys, provides national-level data on annual operating hours by building type and lamp type for all sectors. These operating hours are broken down by application for the commercial and industrial sectors. DOE associates the LMC's operating hours data by building type with the EIA's data by building type and Census Division to derive annual operating hours by Census Division and large States. This allows DOE to correlate the electricity price distribution, and sales tax distribution with the operating hours distribution by Census Division and large States in the LCC spreadsheet.

Using this methodology will allow DOE to conduct a sensitivity analysis to determine how high and low estimates of energy use might impact the economic feasibility of any amended energy conservation standards. DOE will also be able to correlate regional electricity prices and sales tax data to develop a more accurate distribution of the variability in consumer impacts in the LCC analysis.

Item 18 *DOE welcomes comment on use of the planned operating hours profile for fluorescent lamp ballasts in this rule. Furthermore, DOE welcomes comment on whether the end-use operating profiles are different for the various types of fluorescent lamp ballasts covered under this rulemaking, and if so, how.*

7 PRODUCT PRICE DETERMINATION

As stated in section 5, the purpose of the engineering analysis and product price determination together is to provide an analysis of the relationship between the end-user price and efficiency for fluorescent lamp ballasts. Because DOE needs retail (consumer) prices for the baseline efficiency levels under consideration for use in the LCC and PBP analysis and the national impact analysis, DOE will base the product price determination for ballasts on marked-down manufacturer product price schedule lists, developing high-range, medium-range, and low-

[18] U.S. Department of Energy—Office of Energy Efficiency and Renewable Energy, Final Report: U.S. Lighting Market Characterization, Volume I: National Lighting Inventory and Energy Consumption Estimate (2002). Available at: www.eere.energy.gov/buildings/info/documents/pdfs/lmc_vol1_final.pdf.

[19] U.S. Department of Energy—Energy Information Agency, Commercial Building Energy Consumption Survey: Micro-level data, file 2 Building Activities, Special Measures of Size, and Multi-building Facilities (2003). Available at: http://www.eia.doe.gov/emeu/cbecs/public_use.html.

[20] U.S. Department of Energy—Energy Information Agency, Manufacturing Energy Consumption Survey, Table 1.4: Number of Establishments by First Use of Energy for All Purposes (Fuel and Nonfuel) (2002). Available at: http://www.eia.doe.gov/emeu/mecs/mecs2002/data02/shelltables.html.

range end-user retail prices. DOE develops these three different retail price scenarios to account for the pricing variability encountered by consumers. For example, a consumer that is purchasing large quantities of ballasts, such as a State or large corporation, will experience on average lower prices than a consumer who is purchasing similar ballasts in smaller quantities. Using three price points allows DOE to account for the economic impacts on a wide variety of consumers. Once the end-user retail price set is prepared, DOE will compare those prices with publicly-available prices in State procurement contracts, at large electrical supply distributors, and other sources of publicly available end-user prices (*e.g.*, Internet retailers).

To develop low-range prices for ballasts, DOE will calculate a discount off the list price in the manufacturer product price schedule consistent with prices found in State procurement contracts and other sources. DOE believes that using this discount schedule is appropriate for the rulemaking analyses, as it reflects currently-available pricing and because it takes into account commoditization of standards-compliant ballasts.

For medium-range prices, DOE will take a discount off the manufacturer product price schedule list that is consistent with the distributor pricing it receives and that represents a typical discount for commercial institutions on high-volume ballasts. In addition, DOE will add a contractor mark-up so that the resulting price will encompass both a contractor and distributor mark-up.

For the high-range prices, DOE will deduce discounts on commodity ballasts from the manufacturer product price schedule list for small quantity purchasers by observing Internet pricing and obtaining distributor quotes. These prices will also encompass both a contractor and a distributor mark-up.

After determining the high-range, medium-range, and low-range prices, DOE will develop an estimate of the sales tax to apply to the end-user product price. The sales tax represents State and local sales taxes, and is a multiplicative factor that increases the end-user product price. DOE will obtain information on State and local sales tax from the Sales Tax Clearinghouse.[21] This data will be compiled to calculate a national, population-weighted average sales tax as well as a population-weighted average tax for each Census division.

Item 19 *DOE welcomes comment on final end-user prices for high-range, medium-range, and low-range fluorescent ballasts.*

Item 20 *DOE welcomes comment on typical contractor and distributor markups associated with the purchase and installation of fluorescent lamp ballasts.*

[21] The Sales Tax Clearinghouse, Inc. was established in August 1999 to facilitate the calculation of sales and use taxes administered by the Nation's 7,000 taxing authorities at the State, county, and city levels. Information on the Sales Tax Clearinghouse can be found at http://www.thestc.com/.

8 LIFE-CYCLE COST AND PAYBACK PERIOD ANALYSIS

The effects of increased energy conservation standards on consumers include a change in operating expense (usually decreased) and a change in purchase price (usually increased). The LCC of a product is the cost a product incurs over its lifetime, taking into account both purchase price and operating expenses. The PBP represents the time it takes to recover the additional installed cost of the more-efficient device through annual operating cost savings. DOE analyzes the net effect on consumers by calculating the LCC and PBP using the engineering performance data (section 5), the energy-use and end-use load characterization data (section 6), and the product price determination (section 7). Inputs to the LCC calculation include the installed cost to the consumer (purchase price plus installation cost), operating expenses (energy expenses, and, if applicable, repair costs and maintenance costs), the lifetime of the equipment or other defined period of analysis, and a discount rate. Inputs to the payback period calculation include the installed cost to the consumer and annual operating costs.

In addition to the LCC and PBP calculations, for certain products, DOE also conducts a rebuttable presumption analysis. Under 42 U.S.C. 6295(o)(2)(B)(iii), the statute establishes a rebuttable presumption that a standard is economically justified "[i]f the Secretary finds that the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy … savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure…." For fluorescent lamp ballasts, because the DOE test procedure does not include an input for operating hours, DOE plans to use the average annual operating hours of the most common end-use application. While the rebuttable presumption calculation is helpful in understanding that certain standard levels have short payback periods, often DOE has found that some efficiency levels higher that the rebuttable presumption level are cost-justified. Therefore, DOE does not make a determination of economic justification based on this calculation. Economic justification is based on a weighing of the seven EPCA factors described in section 1.3.2 of this Framework Document. The LCC and PBP analysis described in the following section reflects field conditions and is, therefore, a more accurate depiction of consumer impacts.

For the ANOPR, DOE will conduct the LCC and PBP analysis using typical values to reflect conditions in the field for equipment retail price and life, energy costs, energy usage, and discount rates. If DOE determines that there is significant variability in any of the above inputs, it will conduct sensitivity analyses to determine how the LCC and PBP are impacted by high and low estimates for each of the inputs. For any sensitivity analyses that it conducts, DOE will account for correlations that may exist between inputs (*e.g.*, energy usage may be correlated to energy prices). The detailed impact calculation, which DOE will conduct after the ANOPR, may include an assessment of impacts on subgroups of consumers, as described in section 11.

For the NOPR, DOE will carefully review all of the comments it receives on the ANOPR LCC analysis, make any necessary revisions to the analysis, and evaluate additional parameters not included in the ANOPR analysis, if necessary.

For fluorescent lamp ballasts, DOE will need to determine input values for several variables. The following sections discuss the methodologies DOE plans to use to develop energy prices, discount rates, maintenance/repair/installation costs, and ballast lifetimes. Some of the

major inputs DOE is anticipating it will develop for the fluorescent lamp ballast life-cycle cost and PBP analysis are listed in the table below.

Table 8.1 Inputs to the Life-Cycle Cost and Payback Period Analysis

Input	Description
Product Price	The price of certain fluorescent lamp ballasts established in section 7, *Product Price Determination*.
Sales tax	Sales tax is applied to convert the product price to a final consumer price including sales tax. Sales tax mark-ups will be developed in section 7, *Product Price Determination*.
Maintenance, repair, and installation cost	This input represents the cost to customers of installing the ballast as well as the cost of maintaining that ballast.
Annual operating hours	The annual operating hours are the estimated hours that a fluorescent lamp ballast is in use during the time span of one year. Operating hours are developed in section 6, *Energy-use and End-use Load Characterization*.
Product energy consumption rate	The product energy consumption is the site-energy usage rate associated with operating the lamp system developed in section 6, *Energy-use and End-use Load Characterization*
Electricity prices	Electricity prices used in the analysis are the average price per kilowatt-hour (*i.e.*, $/kWh) paid by customers.
Electricity price trends	Electricity price trends estimate the future cost of electricity.
Lifetime	The total hours in operation after which the consumer retires the ballast or components of a ballast system from service.
Discount rate	The discount rate is the rate at which DOE discounts future expenditures to establish their present value.
Analysis Period	Analysis period is the time span over which DOE calculates the LCC.

8.1 Energy Prices

For consumers of fluorescent lamp ballasts, DOE will survey residential, commercial, and industrial energy tariffs[22] as a means for establishing marginal electricity prices. DOE will also use data from CBECS[23] conducted by EIA to estimate building energy use characteristics that impact electricity prices. If the tariff survey and EIA data demonstrate a large variability in electricity prices, DOE will conduct a sensitivity analysis to determine how high and low electricity price estimates might impact the economic feasibility of any amended energy conservation standards. DOE will use projections of national average energy prices for residential, commercial, and industrial consumers—principally from EIA's *Annual Energy Outlook* (*AEO*) from the most recent year available—as input for future energy prices in its LCC analysis.

Item 21 *DOE welcomes input on the electricity prices used in this analysis.*

[22] "Energy tariffs" are the rules for calculating energy bills. DOE contractors maintain a database of hundreds of tariffs that can be used to calculate incremental energy bill impacts from energy savings. See: http://tariffs.lbl.gov/

[23] See: http://www.eia.doe.gov/emeu/cbecs/.

8.2 Life-Cycle Cost Discount Rates

The calculation of consumer LCC requires the use of an appropriate discount rate. DOE uses the discount rate to determine the present value of lifetime operating expenses. For consumers of fluorescent lamp ballasts, DOE will derive the discount rates for commercial and industrial consumers by estimating the cost of capital of companies that purchase commercial equipment. The cost of capital is commonly used to estimate the present value of cash flows to be derived from a typical company project or investment. Most companies use both debt and equity capital to fund investments, so the cost of capital is the weighted-average cost of equity and debt financing. This corporate finance approach is referred to as the "weighted-average cost of capital." However, because the set of commercial or industrial companies purchasing fluorescent lamp ballasts may differ from those who purchase another product such as distribution transformers, each rulemaking requires development of its own targeted discount rates.

DOE will publish the discount rates and associated documentation on the derivation of these discount rates in the ANOPR. It will invite stakeholders to comment specifically on the issue of consumer discount rates during the ANOPR comment period. Based upon consideration of the comments received on the LCC and PBP analysis documented for the ANOPR, DOE will make the necessary changes to the analysis and will reflect those changes in the documentation of the NOPR.

Item 22 *DOE welcomes input on the planned approaches for estimating discount rates for consumers of fluorescent lamp ballasts covered under this rulemaking.*

8.3 Installation, Maintenance, and Repair Costs

Typically, DOE takes into consideration any expected changes to installation, maintenance, and repair costs for covered equipment in a rulemaking. Often, small incremental changes in equipment efficiency would incur little or no change in installation, maintenance, and repair costs over baseline equipment. For equipment with significant energy-efficiency improvements over the baseline, there may be increased installation, maintenance, and repair costs, because such equipment is more likely to incorporate technologies that are not widely available or utilized.

For fluorescent lamp ballasts, DOE intends to handle each of these costs in its LCC analysis as follows:

- Installation costs -- DOE does not expect that installation costs for fluorescent lamp ballasts will change with more energy-efficient ballast designs, as new regulations are not expected to change either the ballast lifetime or the labor costs for installing a standards-compliant ballast.

- Maintenance costs – DOE expects that maintenance costs for fluorescent lamp ballasts could change with more energy-efficient ballast designs. Due to the fact

that maintenance costs include both the installation labor and equipment cost of replacement *lamps* that operate on any given ballast, it is possible that maintenance costs may change. For example, if a certain standard level included a shift in ballast technology from T12 to T8 ballasts, the equipment cost of the replacement T8 lamps may be different from the T12 lamps. That said, DOE does not believe that the labor costs of installing a fluorescent lamp will change with more efficient ballasts. Furthermore, DOE understands that more energy-efficient ballasts would not significantly impact the useful lifetime (*i.e.*, shorter or longer) of the lamps operated by those ballasts.

- Repair costs -- DOE does not believe that fluorescent lamp ballasts are subject to being "repaired," as ballasts are generally simply replaced at the end of their useful life. For this reason, repair costs will not be part of the LCC analysis.

Item 23 *DOE welcomes comment on how to develop installation, maintenance, and (if applicable) repair costs for fluorescent lamp ballasts. In particular, will fluorescent lamp ballast energy conservation standards affect the useful lifetime of the ballasts and/or the fluorescent lamps operated by those ballasts? If the lamps operated by the more efficient ballasts would be impacted, then DOE invites stakeholder comment on whether re-lamping practices (i.e., group re-lamping and spot re-lamping) would change as a result of the standard.*

8.4 Fluorescent Lamp Ballast Lifetimes

DOE will use information from manufacturer product catalogues, various literature sources such as technical reports and conference proceedings, and the 2000 Ballast Rule, as well as input from manufacturers and other stakeholders, to establish fluorescent lamp ballast lifetimes for use in the LCC and subsequent analyses.

Based on consideration of the comments received for the ANOPR, DOE will make necessary changes to the analysis. These changes will be reflected in the documentation of the NOPR.

Item 24 *DOE welcomes comment on appropriate fluorescent lamp ballast lifetimes for the ballasts covered in this rulemaking.*

9 SHIPMENTS ANALYSIS

DOE develops shipment forecasts of products in order to calculate the national impacts of standards on energy consumption, NPV, and future manufacturer cash flows. DOE plans to develop shipments forecasts based on an analysis of key market drivers for the fluorescent lamp ballasts.

9.1 Base Case Forecast

To evaluate the various impacts of standards, DOE develops a base case shipments forecast against which to compare standards-case shipments forecasts at higher efficiency levels (based on the CSLs). DOE will design the base case forecast to depict what would be anticipated to happen to energy consumption and energy costs over time if energy conservation standards for the ballasts covered under this rulemaking are not adopted. In determining the base case forecast, DOE will consider historical shipments, the mix of ballast efficiencies currently sold in the absence of regulation, and how that mix might change over time. For these purposes, DOE needs data on historical equipment shipments and the market shares of the different efficiency levels offered in each product class.

DOE seeks data on historical shipments of fluorescent lamp ballasts, possibly from manufacturers or industry associations. Alternatively, DOE could base its shipments analysis on an extrapolation the shipments analysis from the 2000 Ballast Rulemaking, selected national market reports, and/or the extrapolation of historical sales data from the U.S. Census Bureau. The Census Bureau publishes limited information on the quantity and dollar-value of fluorescent lamp ballast shipments; however, those shipments are not broken down by ballast type or product class. DOE is also interested in stakeholder comment on efficiency trends in the base case (*i.e.*, the trends of consumers purchasing ballasts that use less energy).that would enable DOE to represent these market trends in its analysis.

DOE hopes to develop shipment data within each fluorescent lamp ballast product class, as well as to understand the breakdown of efficiency levels within each product class (*i.e.*, data on the distribution of equipment shipments by BEF). However, DOE recognizes that this information may be difficult to collect, so DOE may ultimately need to consider other approaches, such as interviewing experts who work in the fluorescent lamp ballast market.

> ***Item 25*** *DOE welcomes recommendations on sources of data that would provide information on shipments of fluorescent lamp ballasts by product class and BEF distributions within those product classes. In addition, DOE welcomes comment or recommendations on how it might characterize long-term trends in efficiency of fluorescent lamp ballasts for the base-case shipments forecast.*

9.2 Accounting Methodology

DOE plans to determine annual shipments in the base case by accounting for new ballast installation, ballast replacements due to failure, and ballast retrofits. Each of these three impacts on the accounting methodology is discussed below:

- *New Construction* means the new ballasts that are installed each year due to equipment growth in a particular sector. DOE plans to determine a value for this input by using the National Energy Modeling System (NEMS) growth projections for the commercial and industrial equipment sectors.

- *Replacements* refers to the new ballasts that are installed each year to replace ballasts

that have failed. DOE plans to base this calculation on equipment sales and retirement rates.

- *Retrofits* means the ballasts replacing existing ballasts during renovation and/or repair of equipment. This retrofit replacement may occur before the original ballast has failed.

DOE intends to use an accounting model method to prepare shipment scenarios for the base case and the standards level cases. The model will keep track of the aging and replacement of fluorescent lamp ballasts given a projection of future ballast sales growth.

Item 26 *DOE welcomes comment on the accounting methodology described above for each of the fluorescent lamp ballasts covered in this rulemaking.*

9.3 Standards Impacts on Ballast Shipments

For each ballast type, DOE will develop a set of shipment forecasts for the covered ballasts for each set of efficiency standards analyzed. It will use these standards-case forecasts to evaluate the impacts of standards on ballast shipments. DOE derives standards-case forecasts using the same data sets as it used for the base-case forecasts. However, because the standards-case forecasts take into account the increase in purchase price and the decrease in operating costs caused by standards, forecasted shipments typically deviate from the base case. The magnitude of the difference between the standards-case and base-case shipment forecasts depends on the estimated purchase-price increase, as well as the operating-cost savings from the standard. Because the purchase price tends to have a larger impact than operating cost on equipment purchase decisions, standards-case forecasts typically do show an elasticity of demand, manifested as a drop in shipments relative to the base case.

Market-pull programs, such as consumer rebate programs that encourage the purchase of more efficacious fluorescent lamp ballasts and manufacturer tax credits that encourage the production of more efficacious fluorescent lamp ballasts, also affect standards-case shipment forecasts. To the extent that such programs exist, DOE will consider their impact on the forecast of both standards-case and base-case shipments.

Item 27 *DOE welcomes comment on how any new energy conservation standard for fluorescent lamp ballasts might impact shipments of these ballasts. DOE also invites information about market-pull programs that currently exist to promote the adoption of more-efficacious ballasts.*

10 NATIONAL IMPACT ANALYSIS

The national impact analysis discusses DOE's assessment of the aggregate impacts of potential efficiency standards at the national level. Measures of impact that DOE will report include future NES from CSLs (*i.e.*, the cumulative incremental energy savings from a new or increased energy conservation standard relative to a base case of no change in the energy

conservation national standard over a specified forecast period) and the NPV from CSLs (*i.e.*, the cumulative incremental LCC from a new or increased energy conservation state relative to the base case over a specified forecast period).

10.1 Inputs to Forecasts

Analyzing impacts of Federal energy conservation standards for fluorescent lamp ballasts requires a comparison of projected energy consumption in the United States with, and without, new energy conservation standards. The forecasts contain projections of unit energy consumption of new ballasts, annual equipment shipments, the price of purchased equipment, and base-case and standards-case efficiencies. The derivations of the base-case shipments forecasts are discussed in section 9. Approaches to determine retail prices for equipment are described in section 7, while approaches to determine unit energy consumption are described in section 6.

The rebound effect, another input to the NIA, is discussed in this section. Often, consumers that encounter lower operating costs associated with a more-energy-efficient product will use that product more often than a less-efficient product. The rebound effect analysis accounts for this increase in consumer use. Some of the major inputs DOE is anticipating it will develop for the national impact analysis are described in the table below.

Table 10.1 Inputs to the National Impact Analysis

Input Data	Description of Data Sources
Shipments	Annual shipments developed in section 9.
Stock of Fluorescent Lamp Ballasts	This stock is calculated from the service life of ballasts developed in section 8 and annual shipments from ballasts developed in section 9.
Effective Date of Standard	2014
Analysis Period	2014 to 2043 (30 years)
Base-Case Forecasted Efficiency	Distribution of base-case shipments by efficiency level over time developed in section 9.
Standards-Case Forecasted Efficiency	Distribution of shipments by efficiency level for each standards case over time.
Unit Energy Consumption (kWh/yr)	This is the average energy consumption of a fluorescent lamp ballast established in the energy-use and end-use load characterization, section 6
Total Installed Cost	Established in the Product Price Determination, section 7 and the LCC analysis, section 8.
Electricity Price Forecast	Established in the Life Cycle Cost Analysis, section 8.
Electricity Site-to-Source Conversion	Conversion varies yearly and is generated by EIA *Annual Energy Outlook* forecasts of electricity generation and electricity related losses.
Heating, Ventilating, and Air-Conditioning (HVAC) Interaction Savings	Accounts for the additional energy saved through HVAC interactions. The methodology will be similar to that used in the 2000 Ballast Rule.
Discount Rate	The discount rate is the rate at which DOE discounts future expenditures to establish their present value. 3 and 7 percent discount rates will be used.
Present Year	Future costs and savings will be discounted to the year 2009.
Rebound Effect	The difference between the projected and actual savings due to increased efficiency.

Item 28 *DOE welcomes comment on the data sources it anticipates using to develop inputs for the national impact analysis.*

10.2 Calculation of National Energy Savings

DOE intends to calculate national energy consumption for each year beginning with the expected effective date of the standards. It will calculate national electricity consumption for the base case and each standard level analyzed. DOE plans to perform this calculation through the use of a spreadsheet model that effectively multiplies annual shipment forecasts by unit energy savings, thereby accounting for the stock of equipment affected by standards.

In response to comments by stakeholders who asked for a simple, transparent model, DOE developed NES spreadsheet models for its standards rulemakings starting in 1996, to project energy savings and to demonstrate how the growth in efficiency can be accounted for

over time.[24] Although these models are specific to each product, their general framework is applicable to the entire fluorescent lamp ballast market. It is DOE's expectation that the NES spreadsheet model will provide a stand-alone forecast of national energy savings and NPV for fluorescent lamp ballasts. Based on consideration of comments DOE may receive on the ANOPR, DOE will make any necessary changes to the analysis. It will reflect those changes in the documentation for the NOPR.

Item 29 *DOE welcomes comment on the NES spreadsheet models it plans to use for estimating national impacts of energy conservation standards for fluorescent lamp ballasts.*

10.3 Net Present Value

DOE calculates the national NPV of energy conservation standards in conjunction with the NES. It calculates annual energy expenditures from annual energy consumption by incorporating forecasted energy prices, using the shipment and average energy efficiency forecasts described in section 9. DOE calculates annual equipment expenditures by multiplying the price per unit times the forecasted shipments. The difference between a base-case and a standards-case scenario gives the national energy bill savings and increased equipment expenditure in dollars, and for the fluorescent lamp ballasts rulemaking, this differential will likely result in an NES offset against increased expenditures on ballasts. The difference each year between energy bill savings and increased equipment expenditures is the net savings (if positive) or net costs (if negative). DOE will discount these annual values to the present time and sum them to provide a net present value. Since the national cost of capital may differ from the consumer cost of capital, the discount rate used in the NIA can be different from that used in the LCC. According to U.S. Office of Management and Budget (OMB) guidance, DOE will conduct two NPV calculations, one using a real discount rate of three percent and another using a real discount rate of seven percent (OMB, Circular A-4: Regulatory Analysis, September 17, 2003). The seven-percent and three-percent real discount rates are considered to be representative of the present value of costs and benefits associated with projects in the marketplace facing an average degree of risk. Specifically, the seven-percent real value is an estimate of the average before-tax rate of return to private capital in the U.S. economy. The three-percent real value represents the "societal rate of time preference," which is the rate at which society discounts future consumption flows to their present value. Based on consideration of the comments received on the ANOPR, DOE will make any necessary changes to the analysis and the CSLs.

[24] Several examples of NES spreadsheet models from previous rulemakings can be found on DOE's website at www.eere.energy.gov/buildings/appliance_standards/.

11 LIFE-CYCLE COST SUBGROUP ANALYSIS

At the NOPR stage of this rulemaking, DOE will conduct a life-cycle cost subgroup analysis. In this analysis, DOE analyzes consumer impacts by dividing consumers into subgroups and accounting for variations in key inputs to the LCC analysis. A consumer subgroup comprises a subset of the population that is likely, for one reason or another, to be affected disproportionately by new or revised energy conservation standards (*e.g.*, small businesses, ethnic minorities, low income or senior consumers). The purpose of a subgroup analysis is to determine the extent of any such disproportional impact. DOE will work with stakeholders early in the rulemaking process to identify any subgroups for this consideration. However, as noted above, DOE will not analyze the consumer subgroups until the NOPR stage of the analysis.

In comparing potential impacts on the different consumer subgroups, DOE will evaluate variations in regional electricity prices, variations in usage profiles, and variations in installation costs that might affect the NPV of an energy conservation standard to certain consumer subgroups. To the extent possible, DOE may obtain estimates of the variability in each input factor and consider this variability in its calculation of consumer impacts. It will discuss with stakeholders the variability in each input factor and likely sources of information.

Item 30 *DOE welcomes comment on what, if any, consumer subgroups are appropriate in considering standards for fluorescent lamp ballasts.*

12 MANUFACTURER IMPACT ANALYSIS

DOE announced changes to the manufacturer impact analysis (MIA) approach in a report issued to Congress on January 31, 2006 (as required by section 141 of EPACT 2005). This report, titled "Energy Conservation Standards Activities" (Standards Activities), is available on the DOE website at:
http://www.eere.energy.gov/buildings/appliance_standards/2006_schedule_setting.html.

Previously, DOE did not report any MIA results during the ANOPR phase; however, under this new approach, DOE will collect, evaluate, and report preliminary information and data on manufacturer impacts in the ANOPR. (*See* Standards Activities, page 48.) Such preliminary information includes the anticipated conversion capital expenditures by efficiency level and the corresponding, anticipated impacts on employment. DOE will invite further input on these issues during its ANOPR manufacturer interviews.

DOE intends the MIA to provide an assessment of the potential impacts of energy conservation standards on manufacturers of fluorescent lamp ballasts. DOE intends to conduct a separate manufacturer impact analysis for each of the ballast types covered under this rulemaking. In addition to financial impacts, a wide range of quantitative and qualitative effects

may occur following adoption of a standard that may require changes to the manufacturing practices for these ballasts. DOE will identify these effects through interviews with manufacturers and other experts.

For the NOPR, DOE will supplement the results of the preliminary MIA conducted as part of the ANOPR with more detailed analyses, described in sections 12.1 through 12.5. Specifically, DOE will carry out an industry-wide cash flow analysis using the Government Regulatory Impact Model (GRIM), identify and analyze subgroups of manufacturers whose business varies significantly from the industry as a whole, perform a competitive impacts assessment, and review the cumulative regulatory burden for the industry.

12.1 Sources of Information for the Manufacturer Impact Analysis

Many of the analyses described earlier provide important information that DOE will use as inputs for the manufacturer impact analysis. Such information includes financial parameters developed in the market assessment (section 3.1), retail price forecasts (section 7), and shipments forecasts (section 9). DOE will supplement this information with information gathered during manufacturer interviews.

DOE will conduct detailed interviews with manufacturers to gain insight into the range of potential impacts from standards. The interview process plays a key role in the manufacturer impact analysis, because it provides an opportunity for directly-affected parties to express their views on important issues. During the interviews, DOE will solicit information on the possible impacts on manufacturing costs, equipment prices, sales, direct employment, capital assets, and industry competitiveness. Both qualitative and quantitative information are valuable in terms of this analysis. DOE will schedule interviews well in advance to provide every opportunity for key individuals to be available to participate. In addition, DOE will provide manufacturers with the questionnaires before the interviews in order to facilitate the gathering of the appropriate information. Although a written response to the questionnaire is acceptable, DOE prefers an interactive interview process, because it helps to clarify responses and provides the opportunity to identify additional issues.

DOE will ask interview participants to identify all confidential information provided in writing or orally, and DOE will determine whether the information submitted is entitled to confidential treatment. It will consider the information gathered, as appropriate, in the energy conservation standard decision-making process. DOE will also ask participants to identify any information that they wish to have included in the public record, but that they do not want to have associated with their interview (thereby identifying that particular manufacturer); DOE will incorporate this information into the public record, but will report it without attribution.

DOE will collate the interview results and prepare a summary of the major issues and outcomes. This summary will become part of the technical support document for this rulemaking.

12.2 Industry Cash Flow Analysis

The industry cash flow analysis will rely primarily on the GRIM. DOE uses the GRIM to analyze the financial impacts of new or more stringent energy conservation standards on the industry that produces the equipment covered by the standard.

The GRIM analysis uses a number of factors—annual expected revenues; manufacturer costs such as costs of goods sold; selling, general, and administrative costs; taxes; and capital expenditures (both ordinary capital expenditures and those related to standards)—to determine annual cash flows associated with a new standard, beginning from the announcement of the standard and continuing for several years after its implementation. DOE compares the results against base-case projections that involve no new standards. The financial impact of new standards is the difference between the two sets of discounted annual cash flows. Other performance metrics, such as return on invested capital, are also available from the GRIM.

DOE will gather the inputs needed for the GRIM from two primary sources: (1) the analyses conducted to this point; and (2) interviews with manufacturers and other stakeholders. Information gathered from previous analyses will include financial parameters, manufacturing costs, price forecasts, and shipments forecasts. Interviews with manufacturers and other stakeholders will be essential in supplementing this information.

12.3 Manufacturer Subgroup Analysis

It is possible that the use of average industry cost values may not adequately assess differential impacts among subgroups of ballast manufacturers. DOE recognizes that smaller manufacturers, niche players, and manufacturers exhibiting a cost structure that differs significantly from the industry average may be impacted differently by the imposition of standards. Ideally, DOE would consider the impact on every firm individually. In highly concentrated industries, this may be possible. In industries having numerous participants, however, DOE uses the results of the market and technology assessment to group manufacturers into subgroups, as appropriate. For ballasts, DOE does not intend to assess the impacts on every manufacturer individually, and, therefore, is interested in stakeholder feedback about potential subgroups.

The detailed manufacturer subgroup impact analysis will entail calculating cash flows separately for each defined class of manufacturer.

Item 31 *If appropriate, what are potential subgroups of fluorescent lamp ballast manufacturers that DOE should consider in a manufacturer subgroup analysis?*

12.4 Competitive Impacts Analysis

EPCA directs DOE to consider any lessening of competition that is likely to result from an imposition of standards. (42 U.S.C. 6295(o)(2)(B)(i)(V)) It further directs the Attorney

General to determine in writing the impacts, if any, of any lessening of competition. (42 U.S.C. 6295(o)(2)(B)(ii))

DOE will make a determined effort to gather firm-specific financial information and impacts, and it will then report the aggregated impact of the standard on manufacturers. The competitive impacts analysis will focus on assessing the impacts to smaller, yet significant, manufacturers. DOE will base the assessment on manufacturing cost data and on information collected from interviews with manufacturers. The manufacturer interviews will focus on gathering information that would help in assessing asymmetrical cost increases to some manufacturers, increased proportion of fixed costs potentially increasing business risks, and potential barriers to market entry (*e.g.*, proprietary technologies). DOE will provide the Attorney General with a copy of the NOPR for consideration in his evaluation of the impact of standards on the lessening of competition.

12.5 Cumulative Regulatory Burden

DOE is aware that other regulations may apply to equipment covered under this rulemaking, as well as to other equipment produced by the same manufacturers of equipment covered under this rulemaking. Multiple regulations may result in a significant, cumulative regulatory burden on these manufacturers. DOE will analyze and consider the impact on ballast manufacturers of multiple, equipment-specific regulatory actions.

Regulations that could affect the industry impacted by this rulemaking include:

- Energy conservation standards for fluorescent lamp ballasts established by DOE on September 19, 2000 (65 FR 56740) and by EPACT 2005;
- New EPCA standards, prescribed in EPACT 2005, for medium-base compact fluorescent lamps and mercury vapor lamp ballasts;
- New EPCA standards for incandescent lamps and metal halide lamp fixtures prescribed in EISA 2007 (see Appendix D);
- Existing and/or proposed State standards for high intensity discharge ballasts, and/or under-cabinet luminaires;
- State building energy codes lighting requirements (*e.g.*, American Society of Heating, Refrigerating, and Air-Conditioning Engineers Standard 90.1); and
- International standards, including Canada's regulation of fluorescent lamp ballasts.

Item 32 *DOE welcomes comment on what other regulations or pending regulations it should consider in its examination of cumulative regulatory burden.*

13 UTILITY IMPACT ANALYSIS

Like the life-cycle cost subgroup analysis, the utility impact analysis is completed during the NOPR stage of this rulemaking. In the utility impact analysis, DOE estimates the effects of energy conservation standards for fluorescent lamp ballasts on electricity sales for the electric utility industry. In order to quantify this impact, DOE plans to use a variant of EIA's NEMS,

called NEMS-BT (BT refers to DOE's Office of Building Technologies Program).[25] NEMS is a large, multi-sectoral partial-equilibrium model of the U.S. energy sector, used primarily for the purpose of preparing the *AEO*. NEMS-BT is a customized version of NEMS which incorporates revisions to the NEMS model that are appropriate for the rulemaking analyses conducted by DOE's Office of Building Technologies. NEMS-BT provides the reference case forecast for the United States through 2030 and is available in the public domain.

The utility impact analysis is a comparison between the NEMS-BT model results for the base case and standards cases. Outputs of the utility impact analysis usually parallel results that appear in the latest *AEO*, with some additions. Typical outputs include forecasts of electricity generation, sales, price, and avoided capacity. DOE plans to conduct the utility impact analysis as a scenario departing from the latest *AEO* reference case. In other words, DOE will model the energy savings impacts from energy conservation standards for fluorescent lamp ballasts using NEMS-BT to generate forecasts that deviate from the *AEO* reference case.[26]

Item 33 *DOE welcomes input from stakeholders on its plans to use NEMS-BT to conduct the utility impact analysis.*

14 EMPLOYMENT IMPACT ANALYSIS

DOE includes employment impacts among the factors considered in selecting a proposed efficiency standard, and it also considers the impact of CSLs on both direct and indirect employment. There is a general presumption against any CSL that would directly cause plant closures or significant loss of domestic employment, unless specifically identified expected benefits of the standard would outweigh such adverse effects. (*See* the Process Rule, 10 CFR Part 430, Subpart C, Appendix A, sections 4(d)(7)(ii) and (vi), and 5(e)(3)(i)(B).)

During the NOPR stage of the fluorescent lamp ballast rulemaking, DOE will estimate the impacts of standards on employment for equipment manufacturers, relevant service industries, energy suppliers, and the economy in general. Its analysis covers both direct and indirect employment impacts. Direct employment impacts would result if standards led to a change in the number of employees at manufacturing plants and related supply and service firms. Direct impact estimates are covered in the manufacturer impact analysis.

[25] For more information on NEMS, please refer to the U.S. Department of Energy, Energy Information Administration documentation. A useful summary is National Energy Modeling System: An Overview 2000, DOE/EIA-0581(March 2000). EIA approves use of the name NEMS to describe only an official version of the model without any modification to code or data. Because this analysis entails some minor code modifications and the model is run under various policy scenarios that are variations on EIA assumptions, DOE refers to the model by the name NEMS-BT ("BT" refers to DOE's Building Technologies Program, under whose aegis this work has been performed).

[26] Several NEMS-BT models from previous rulemakings can be found on the DOE's website at www.eere.energy.gov/buildings/appliance_standards/.

Indirect employment impacts are impacts on the national economy other than in the manufacturing sector being regulated. Indirect impacts may result both from expenditures shifting among goods (the substitution effect) and changes in income that lead to a change in overall expenditure levels (the income effect). DOE defines indirect employment impacts from standards as net jobs eliminated or created in the general economy as a result of increased spending driven by the increased equipment prices and reduced spending on energy.

DOE will investigate the combined direct and indirect employment impacts in the employment impact analysis using the Pacific Northwest National Laboratory (PNNL)'s "Impact of Sector Energy Technologies" (ImSET) model. PNNL developed ImSET for DOE's Office of Planning, Budget, and Analysis. The model estimates the employment and income effects of energy-saving technologies in buildings, industry, and transportation. In comparison with simple economic multiplier approaches, ImSET allows for more complete and automated analysis of the economic impacts of energy efficiency investments. Although DOE intends to use ImSET for its analysis of employment impacts, it welcomes input on other tools and factors it might consider.

Item 34 *DOE welcomes feedback on its planned approach for assessing national employment impacts, both direct and indirect.*

15 ENVIRONMENTAL ASSESSMENT

During the NOPR stage of this rulemaking, DOE will conduct an environmental assessment. The intent of the environmental assessment is to provide emissions results estimates, and to fulfill requirements to properly quantify and consider the environmental effects of all new Federal rules. In this rulemaking, the environmental assessment will consider potential environmental impacts from three pollutants (sulfur dioxide (SO_2), nitrous oxide (NO_x), and mercury (Hg)), and from carbon dioxide (CO_2) emissions.

The primary environmental effects of energy conservation standards for fluorescent lamp ballasts are likely to be reduced emissions resulting from reduced electricity consumption. At the NOPR rulemaking stage, for each of the trial standard levels, DOE will calculate total undiscounted and discounted power plant emissions using NEMS-BT, and will use other methods to calculate site emissions. The environmental assessment performed in this rulemaking will be conducted as an incremental policy impact (*i.e.*, a standard for the product under evaluation) of the most current *AEO* forecast, applying the same basic set of assumptions used in *AEO*. Also, forecasts conducted with NEMS-BT consider the supply-side and demand-side effects on the electric utility industry. Thus, DOE's analysis will account for any factors affecting the type of electricity generation and, in turn, the type and amount of airborne emissions generated by the utility industry.

The NEMS-BT model tracks CO_2 emissions with a specialized carbon emissions estimation subroutine, producing reasonably accurate results due to the broad coverage of all

sectors and inclusion of interactive effects. Past experience with carbon results from NEMS suggests that emissions estimates are somewhat lower than emissions based on simple average factors. One of the reasons for this divergence is that NEMS tends to predict that conservation displaces new generating capacity in future years, and new generating capacity is expected to be more efficient than most existing capacity. On the whole, NEMS-BT provides carbon emissions results of reasonable accuracy, at a level consistent with other Federal published results. In addition to providing estimates of the quantitative impacts of ballast efficiency standards on carbon emissions, DOE may consider the use of monetary values to represent the potential value of such emission reductions. DOE invites comments on how to estimate such monetary values or on any widely accepted values that might be used in DOE's analysis.

NEMS-BT also reports SO_2, NO_x, and Hg, which DOE has reported in past analyses. The Clean Air Act Amendments of 1990 set an SO_2 emissions cap on all power generation. The attainment of this target, however, is flexible among generators through the use of emissions allowances and tradable permits. Although NEMS includes a module for SO_2 allowance trading and delivers a forecast of SO_2 allowance prices, accurate simulation of SO_2 trading implies that the effect of efficiency standards on physical emissions will be zero because emissions will always be at or near the ceiling. However, there is an SO_2 benefit from energy conservation, in the form of a lower SO_2 allowance price. But since the impact of any one standard on the allowance price is likely small and highly uncertain, DOE does not plan to monetize the SO_2 benefit.

NEMS-BT also has an algorithm for estimating NO_x emissions from power generation. The impact of these emissions, however, will be affected by the Clean Air Interstate Rule (CAIR), which the Environmental Protection Agency (EPA) issued on March 10, 2005. CAIR will permanently cap emissions of NO_x in 28 eastern states and the District of Columbia. 70 FR 25162 (May 12, 2005). As with SO_2 emissions, a cap on NO_x emissions means that equipment efficiency standards may have little or no physical effect on these emissions. When NO_x emissions are subject to emissions caps, DOE's emissions reduction estimate corresponds to incremental changes in the prices of emissions allowances in cap-and-trade emissions markets rather than physical emissions reductions. Therefore, while the emissions cap may mean that physical emissions reductions will not result from standards, standards could produce an environmental-related economic benefit in the form of lower prices for emissions allowance credits. However, as with SO_2 allowance prices, DOE does not plan to monetize this benefit because the impact on the NO_x allowance price from any single energy conservation standard is likely small and highly uncertain.

With regard to mercury emissions, NEMS-BT has an algorithm for estimating these emissions from power generation. However, the impact on mercury emissions will be affected by the Clean Air Mercury Rule (CAMR), which the EPA published on May 18, 2005. 70 FR 28606. As of 2010, CAMR will permanently cap emissions of mercury for new and existing coal-fired plants in all States. As with SO_2 and NO_x emissions, a cap on mercury emissions means that appliance efficiency standards may have no physical effect on these emissions. When mercury emissions are subject to emissions caps, DOE's emissions reduction estimate corresponds to incremental changes in the prices of emissions allowances in cap-and-trade emissions markets rather than physical emissions reductions. Therefore, while the emissions cap

may mean that physical emissions reductions will not result from standards, standards could produce an economic benefit in the form of lower prices for emissions allowance credits. However, as with SO_2 and NO_x allowance prices, DOE does not plan to monetize this benefit because the impact on the mercury allowance price from any single energy conservation standard is likely small and highly uncertain.

Item 35 *DOE welcomes feedback on its planned approach to assessing national environmental impacts, including other factors or approaches that should be considered.*

16 REGULATORY IMPACT ANALYSIS

In the NOPR stage of this rulemaking, DOE will prepare a regulatory impact analysis. The regulatory impact analysis will address the potential for non-regulatory approaches to supplant or augment energy conservation standards to improve the efficiency of fluorescent lamp ballasts in the market.

The regulatory impact analysis will consider the likely effects of non-regulatory initiatives on ballast energy use, consumer utility, and life-cycle costs. DOE will take into account the actual impacts of any existing initiatives to date, but also will consider historical information presented that may reasonably estimate the impacts that any such initiative might have in the future. DOE will use the NES spreadsheet model (as discussed in section 10.2, "Calculation of National Energy Savings") to calculate the NES and NPV for the alternatives to the potential conservation standards under consideration.

If DOE proposes energy conservation standards for fluorescent lamp ballasts, and if the proposed rule constitutes a significant regulatory action, DOE would prepare and submit to OMB for review the assessment of costs and benefits required under section 6(a)(3) of Executive Order 12866, "Regulatory Planning and Review," 58 FR 51735 (October 4, 1993). The Executive Order requires agencies to identify the specific market failure or other specific problem that it intends to address that warrant new agency action, as well as assess the significance of that problem, to enable assessment of whether any new regulation is warranted. (Executive Order 12866, section 1(b)(1)). Without a market failure, a regulation cannot result in net benefits. DOE discusses potential market failures in Section 3.1 of this Framework Document, and invites stakeholders to comment on them.

Of course, there are likely to be certain "external" benefits resulting from the improved efficacy of ballasts that are not captured by the users of such equipment. These include both environmental and energy security-related externalities that are not already reflected in energy prices such as reduced emissions of greenhouse gases and reduced use of natural gas (and oil) for electricity generation. DOE invites comments on the weight that should be given to these factors

in DOE's determination of the maximum efficiency level at which the total benefits are likely to exceed the total burdens resulting from a DOE standard.

APPENDIX A – EPCA DIRECTIVES REGARDING FLUORESCENT LAMP BALLASTS

This appendix lists the relevant statutory requirements under 42 U.S.C. 6295(g) (*i.e.*, section 325(g) of EPCA, as amended by the Energy Policy Act of 2005) that apply to fluorescent lamp ballasts, as well as standards established by DOE in the 2000 Ballast Rule.

42 U.S.C. 6295(g). Standards for dishwashers; clothes washers; clothes dryers; fluorescent lamp ballasts

(5) Except as provided in paragraph (6), each fluorescent lamp ballast--

(A) (i) manufactured on or after January 1, 1990;

(ii) sold by the manufacturer on or after April 1, 1990; or

(iii) incorporated into a luminaire by a luminaire manufacturer on or after April 1, 1991; and

(B) designed--

(i) to operate at nominal input voltages of 120 or 277 volts;

(ii) to operate with an input current frequency of 60 Hertz; and

(iii) for use in connection with an F40T12, F96T12, or F96T12HO lamps;

(C) shall have a power factor of 0.90 or greater and shall have a ballast efficacy factor not less than the following:

Application for Operation of	Ballast Input Voltage	Total Nominal Lamp Watts	Ballast Efficacy Factor
One F40T12 lamp	120	40	1.805
	277	40	1.805
Two F40T12 lamps	120	80	1.060
	277	80	1.050
Two F96T12 lamps	120	150	0.570
	277	150	0.570
Two F96T12HO lamps	120	220	0.390
	277	220	0.390

(6) The standards described in paragraph (5) do not apply to

(A) a ballast which is designed for dimming or for use in ambient temperatures of 0° F or less, or

(B) a ballast which has a power factor of less than 0.90 and is designed and labeled for use only in residential building applications.

(7) (A) The Secretary shall publish a final rule no later than January 1, 1992, to determine if the standards established under paragraph (5) should be amended, including whether such standards should be amended so that they would be applicable to ballasts described in paragraph (6) and other fluorescent lamp ballasts. Such rule shall contain such

amendment, if any, and provide that the amendment shall apply to products manufactured on or after January 1, 1995.

(B) After January 1, 1992, the Secretary shall publish a final rule no later than five years after the date of publication of a previous final rule. The Secretary shall determine in such rule whether to amend the standards in effect for fluorescent lamp ballasts, including whether such standards should be amended so that they would be applicable to additional fluorescent lamp ballasts.

(C) Any amendment prescribed under subparagraph (B) shall apply to products manufactured after a date which is five years after--

(i) the effective date of the previous amendment; or

(ii) if the previous final rule did not amend the standards, the earliest date by which a previous amendment could have been effective;

except that in no case may any amended standard apply to products manufactured within three years after publication of the final rule establishing such amended standard.

(8)(A) Each fluorescent lamp ballast (other than replacement ballasts or ballasts described in subparagraph (C))—

(i) (I) manufactured on or after July 1, 2009;

(II) sold by the manufacturer on or after October 1, 2009; or

(III) incorporated into a luminaire by a luminaire manufacturer on or after July 1, 2010; and

(ii) designed—

(I) to operate at nominal input voltages of 120 or 277 volts;

(II) to operate with an input current frequency of 60 Hertz; and

(III) for use in connection with F34T12 lamps, F96T12/ES lamps, or F96T12HO/ES lamps; shall have a power factor of 0.90 or greater and shall have a ballast efficacy factor of not less than the following:

Application for Operation of	***Ballast Input Voltage***	***Total Nominal Lamp Watts***	***Ballast Efficacy Factor***
One F34T12 lamp	*120*	*34*	*2.61*
	277	*34*	*2.61*
Two F34T12 lamps	*120*	*68*	*1.35*
	277	*68*	*1.35*
Two F96T12/ES lamps	*120*	*120*	*0.77*
	277	*120*	*0.77*
Two F96T12HO/ES	*120*	*190*	*0.42*
	277	*190*	*0.42*

(B) The standards described in subparagraph (A) shall apply to all ballasts covered by subparagraph (A)(ii) that are manufactured on or after July 1, 2010, or sold by the manufacturer on or after October 1, 2010.

(C) The standards described in subparagraph (A) do not apply to—

(i) a ballast that is designed for dimming to 50 percent or less of the maximum output of the ballast;

(ii) a ballast that is designed for use with 2 F96T12HO lamps at ambient temperatures of 20°F or less and for use in an outdoor sign; or

(iii) a ballast that has a power factor of less than 0.90 and is designed and labeled for use only in residential applications.;

10 CFR 430.32(m) Energy Conservation Standards

(m)(1) Fluorescent lamp ballasts. Except as provided in paragraphs (m)(2), (m)(3), (m)(4), (m)(5), (m)(6) and (m)(7) of this section, each fluorescent lamp ballast—

(i) (A) Manufactured on or after January 1, 1990;
(B) Sold by the manufacturer on or after April 1, 1990; or
(C) Incorporated into a luminaire by a luminaire manufacturer on or after April 1, 1991; and

(ii) Designed—
(A) To operate at nominal input voltages of 120 or 277 volts;
(B) To operate with an input current frequency of 60 Hertz; and
(C) For use in connection with an F40T12, F96T12, or F96T12HO lamps shall have a power factor of 0.90 or greater and shall have a ballast efficacy factor not less than the following:

Application for Operation of	Ballast Input Voltage	Total Nominal Lamp Watts	Ballast Efficacy Factor
One F40T12 lamp	120	40	1.805
	277	40	1.805
Two F40T12 lamps	120	80	1.060
	277	80	1.050
Two F96T12 lamps	120	150	0.570
	277	150	0.570
Two F96T12HO lamps	120	220	0.390
	277	220	0.390

(2) The standards described in paragraph (m)(1) of this section do not apply to—

(i) A ballast that is designed for dimming or for use in ambient temperatures of 0 °F or less, or

(ii) A ballast that has a power factor of less than 0.90 and is designed for use only in residential building applications.

(3) Except as provided in paragraph (m)(4) of this section, each fluorescent lamp ballast—

(i) (A) Manufactured on or after April 1, 2005;
(B) Sold by the manufacturer on or after July 1, 2005; or
(C) Incorporated into a luminaire by a luminaire manufacturer on or after April 1, 2006; and

(ii) Designed—
(A) To operate at nominal input voltages of 120 or 277 volts;

(B) To operate with an input current frequency of 60 Hertz; and

(C) For use in connection with an F40T12, F96T12, or F96T12HO lamps; shall have a power factor of 0.90 or greater and shall have a ballast efficacy factor not less than the following:

Application for Operation of	Ballast Input Voltage	Total Nominal Lamp Watts	Ballast Efficacy Factor
One F40 T12 lamp	120	40	2.29
	277	40	2.29
Two F40 T12 lamps	120	80	1.17
	277	80	1.17
Two F96T12 lamps	120	150	0.63
	277	150	0.63
Two F96T12HO lamps	120	220	0.39
	277	220	0.39

(4) (i) The standards described in paragraph (m)(3) do not apply to:

(A) A ballast that is designed for dimming to 50 percent or less of its maximum output;

(B) A ballast that is designed for use with two F96T12HO lamps at ambient temperatures of −20 °F or less and for use in an outdoor sign;

(C) A ballast that has a power factor of less than 0.90 and is designed and labeled for use only in residential building applications; or

(D) A replacement ballast as defined in paragraph (m)(4)(ii) of this section.

(ii) For purposes of this paragraph (m), a replacement ballast is defined as a ballast that:

(A) Is manufactured on or before June 30, 2010;

(B) Is designed for use to replace an existing ballast in a previously installed luminaire;

(C) Is marked "FOR REPLACEMENT USE ONLY";

(D) Is shipped by the manufacturer in packages containing not more than 10 ballasts;

(E) Has output leads that when fully extended are a total length that is less than the length of the lamp with which it is intended to be operated; and

(F) Meets or exceeds the ballast efficacy factor in the following table:

Application for Operation of	Ballast Input Voltage	Total Nominal Lamp Watts	Ballast Efficacy Factor
One F40T12 lamp	120	40	1.805
	277	40	1.805
Two F40T12 lamps	120	80	1.060
	277	80	1.050
Two F96T12 lamps	120	150	0.570
	277	150	0.570
Two F96T12HO lamps	120	220	0.390
	277	220	0.390

(5) Except as provided in paragraph (m)(7) of this section, each fluorescent lamp ballast (other than replacement ballasts defined in §430.2)—

(i) (A) Manufactured on or after July 1, 2009;

(B) Sold by the manufacturer on or after October 1, 2009; or

(C) Incorporated into a luminaire by a luminaire manufacturer on or after July 1, 2010; and

(ii) Designed—

(A) To operate at nominal input voltages of 120 or 277 volts;

(B) To operate with an input current frequency of 60 Hertz; and

(C) For use in connection with F34T12 lamps, F96T12/ES lamps, or F96T12HO/ES lamps; shall have a power factor of 0.90 or greater and shall have a ballast efficacy factor of not less than the following:

Application for Operation of	Ballast Input Voltage	Total Nominal Lamp Watts	Ballast Efficacy Factor
One F34 T12 lamp	120	34	2.61
	277	34	2.61
Two F34 T12 lamps	120	68	1.35
	277	68	1.35
Two F96T12/ES lamps	120	120	0.77
	277	120	0.77
Two F96T12HO/ES lamps	120	190	0.42
	277	190	0.42

(6) The standards in paragraph (m)(5) shall apply to all ballasts covered by paragraph (m)(5)(ii), including replacement ballasts and ballasts described in paragraph (m)(7) of this section, that are manufactured on or after July 1, 2010, or sold by the manufacturer on or after October 1, 2010.

(7) The standards in paragraph (m)(5) do not apply to—

(i) A ballast that is designed for dimming to 50 percent or less of the maximum output of the ballast;

(ii) A ballast that is designed for use with 2 F96T12HO lamps at ambient temperatures of 20 degrees F or less and for use in an outdoor sign; or

(iii) A ballast that has a power factor of less than 0.90 and is designed and labeled for use only in residential applications.

APPENDIX B - DEFINITIONS

This appendix provides relevant definitions under the statute (42 U.S.C. 6291) and DOE regulations (10 CFR 430.2) that are applicable to the lighting products covered under this rulemaking. DOE takes the definitions from the statute and codifies them into the CFR; therefore, some terms in this appendix may be listed twice. Please note that due to the recent enactment of EISA 2007 (Pub. L. 110-140; December 19, 2007), some terms may only be defined in the statute at the time this Framework Document is published, as they have not yet be codified into the CFR.

STATUTORY DEFINITIONS

"Fluorescent Lamp Ballast"

42 U.S.C. 6291(29)

(A) The term "fluorescent lamp ballast" means a device which is used to start and operate fluorescent lamps by providing a starting voltage and current and limiting the current during normal operation.

(B) The term "ANSI standard" means a standard developed by a committee accredited by the American National Standards Institute.

(C) The term "ballast efficacy factor" means the relative light output divided by the power input of a fluorescent lamp ballast, as measured under test conditions specified in ANSI standard C82.2-1984, or as may be prescribed by the Secretary.

(D)(i) The term "F40T12 lamp" means a nominal 40 watt tubular fluorescent lamp which is 48 inches in length and one-and-a-half inches in diameter, and conforms to ANSI standard C78.81-2003 (Data Sheet 7881-ANSI-1010-1).

(ii) The term "F96T12 lamp" means a nominal 75 watt tubular fluorescent lamp which is 96 inches in length and one-and-a-half inches in diameter, and conforms to ANSI standard C78.81-2003 (Data Sheet 7881-ANSI-3007-1).

(iii) The term "F96T12HO lamp" means a nominal 110 watt tubular fluorescent lamp which is 96 inches in length and one-and-a-half inches in diameter, and conforms to ANSI standard C78.81-2003 (Data Sheet 7881-ANSI-1019-1).

(E) The term "input current" means the root-mean-square (RMS) current in amperes delivered to a fluorescent lamp ballast.

(F) The term "luminaire" means a complete lighting unit consisting of a fluorescent lamp or lamps, together with parts designed to distribute the light, to position and protect such lamps, and to connect such lamps to the power supply through the ballast.

(G) The term "ballast input voltage" means the rated input voltage of a fluorescent lamp ballast.

(H) The term "nominal lamp watts" means the wattage at which a fluorescent lamp is designed to operate.

(I) The term "power factor" means the power input divided by the product of ballast input voltage and input current of a fluorescent lamp ballast, as measured under

test conditions specified in ANSI standard C82.2-1984, or as may be prescribed by the Secretary.

(J) The term "power input" means the power consumption in watts of a ballast and fluorescent lamp or lamps, as determined in accordance with the test procedures specified in ANSI standard C82.2-1984, or as may be prescribed by the Secretary.

(K) The term "relative light output" means the light output delivered through the use of a ballast divided by the light output delivered through the use of a reference ballast, expressed as a percent, as determined in accordance with the test procedures specified in ANSI standard C82.2-1984, or as may be prescribed by the Secretary.

(L) The term "residential building" means a structure or portion of a structure which provides facilities or shelter for human residency, except that such term does not include any multifamily residential structure of more than three stories above grade.

(*M) The term ``lamp efficacy'' means the lumen output of a lamp divided by its wattage, expressed in lumens per watt (LPW).*

(N) The term ``lamp type'' means all lamps designated as having the same electrical and lighting characteristics and made by one manufacturer.

(O) The term ``lamp wattage'' means the total electrical power consumed by a lamp in watts, after the initial seasoning period referenced in the appropriate IES standard test procedure and including, for fluorescent, arc watts plus cathode watts.

(P) The terms ``life'' and ``lifetime'' mean length of operating time of a statistically large group of lamps between first use and failure of 50 percent of the group in accordance with test procedures described in the IES Lighting Handbook-Reference Volume.

"Fluorescent Lamps"

42 U.S.C. 6291(30)(A)

(A) Except as provided in subparagraph (E), the term "fluorescent lamp" means a low pressure mercury electric-discharge source in which a fluorescing coating transforms some of the ultraviolet energy generated by the mercury discharge into light, including only the following:

(i) Any straight-shaped lamp (commonly referred to as 4-foot medium bi-pin lamps) with medium bi-pin bases of nominal overall length of 48 inches and rated wattage of 28 or more.

(ii) Any U-shaped lamp (commonly referred to as 2-foot U-shaped lamps) with medium bi-pin bases of nominal overall length between 22 and 25 inches and rated wattage of 28 or more.

(iii)Any rapid start lamp (commonly referred to as 8-foot high output lamps) with recessed double contact bases of nominal overall length of 96 inches and 0.800 nominal amperes, as defined in ANSI C78.1-1978 and related supplements.

(iv) Any instant start lamp (commonly referred to as 8-foot slimline lamps) with single pin bases of nominal overall length of 96 inches and rated wattage of 52 or more,

as defined in ANSI C78.3-1978 (R1984) and related supplement ANSI C78.3a-1985.

42 U.S.C. 6291(30)(E)

(E) The terms "fluorescent lamp" and "incandescent lamp" do not include any lamp excluded by the Secretary, by rule, as a result of a determination that standards for such lamp would not result in significant energy savings because such lamp is designed for special applications or has special characteristics not available in reasonably substitutable lamp types.

"Ballast"

42 U.S.C. 6291(58)

The term `ballast' means a device used with an electric discharge lamp to obtain necessary circuit conditions (voltage, current, and waveform) for starting and operating.

"Electronic Ballast"

42 U.S.C. 6291(60)

The term `electronic ballast' means a device that uses semiconductors as the primary means to control lamp starting and operation.

DEFINITIONS IN DOE REGULATIONS

10 CFR 430.2 – Definitions

Ballast efficacy factor means the relative light output divided by the power input of a fluorescent lamp ballast, as measured under test conditions specified in ANSI Standard C82.2–1984.

Fluorescent lamp means a low pressure mercury electric-discharge source in which a fluorescing coating transforms some of the ultraviolet energy generated by the mercury discharge into light, including only the following:

(1) Any straight-shaped lamp (commonly referred to as 4-foot medium bi-pin lamps) with medium bi-pin bases of nominal overall length of 48 inches and rated wattage of 28 or more.

(2) Any U-shaped lamp (commonly referred to as 2-foot U-shaped lamps) with medium bi-pin bases of nominal overall length between 22 and 25 inches and rated wattage of 28 or more.
(3) Any rapid start lamp (commonly referred to as 8-foot high output lamps) with recessed double contact bases of nominal overall length of 96 inches and 0.800 nominal amperes, as defined in ANSI C78.1–1991.
(4) Any instant start lamp (commonly referred to as 8-foot slimline lamps) with single pin bases of nominal overall length of 96 inches and rated wattage of 52 or more, as defined in ANSI C78.3–1991.

Fluorescent lamp ballast means a device which is used to start and operate fluorescent lamps by providing a starting voltage and current and limiting the current during normal operation.

Replacement ballast means a ballast that—

(1) Is designed for use to replace an existing fluorescent lamp ballast in a previously installed luminaire;
(2) Is marked "FOR REPLACEMENT USE ONLY";
(3) Is shipped by the manufacturer in packages containing not more than 10 fluorescent lamp ballasts; and
(4) Has output leads that when fully extended are a total length that is less than the length of the lamp with which the ballast is intended to be operated.

APPENDIX C – TEST PROCEDURES

This appendix provides the DOE test procedures for measuring the energy consumption of fluorescent lamp ballasts, as contained in 10 CFR 430, Subpart B, Appendix Q.

Appendix Q to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Fluorescent Lamp Ballasts

1. Definitions

1.1 *ANSI Standard* means a standard developed by a committee accredited by the American National Standards Institute.

1.2 *Ballast input voltage* means the rated input voltage of a fluorescent lamp ballast.

1.3 *F4OT12 lamp* means a nominal 40 watt tubular fluorescent lamp which is 48 inches in length and one and a half inches in diameter, and conforms to ANSI standard C78.81–2003 (Data Sheet 7881–ANSI–1010–1).

1.4 *F96T12 lamp* means a nominal 75 watt tubular fluorescent lamp which is 96 inches in length and one and one-half inches in diameter, and conforms to ANSI Standard C78.81–2003 (Data Sheet 7881–ANSI–3007–1).

1.5 *F96T12HO lamp* means a nominal 110 watt tubular fluorescent lamp that is 96 inches in length and 1 1/2 inches in diameter, and conforms to ANSI standard C78.81–2003 (Data Sheet 7881–ANSI–1019–1).

1.6 *F34T12 lamp* (also known as a "F40T12/ES lamp") means a nominal 34 watt tubular fluorescent lamp that is 48 inches in length and 1 1/2 inches in diameter, and conforms to ANSI standard C78.81–2003 (Data Sheet 7881–ANSI–1006–1).

1.7 *F96T12/ES lamp* means a nominal 60 watt tubular fluorescent lamp that is 96 inches in length and 1 1/2 inches in diameter, and conforms to ANSI standard C78.81–2003 (Data Sheet 7881–ANSI–3006–1).

1.8 *F96T12HO/ES lamp* means a nominal 95 watt tubular fluorescent lamp that is 96 inches in length and 1 1/2 inches in diameter, and conforms to ANSI standard C78.81–2003 (Data Sheet 7881–ANSI–1017–1).

1.9 *Input current* means the root-mean-square (RMS) current in amperes delivered to a fluorescent lamp ballast.

1.10 *Luminaire* means a complete lighting unit consisting of a fluorescent lamp or lamps, together with parts designed to distribute the light, to position and protect such lamps, and to connect such lamps to the power supply through the ballast.

1.11 *Nominal lamp watts* means the wattage at which a fluorescent lamp is designed to operate.

1.12 *Power factor* means the power input divided by the product of ballast input voltage and input current of a fluorescent lamp ballast, as measured under test conditions specified in ANSI Standard C82.2–1984.

1.13 *Power input* means the power consumption in watts of a ballast and fluorescent lamp or lamps, as determined in accordance with the test procedures specified in ANSI Standard C82.2–1984.

1.14 *Relative light output* means the light output delivered through the use of a ballast divided by the light output delivered through the use of a reference ballast, expressed as a percent, as determined in accordance with the test procedures specified in ANSI Standard C82.2–1984.

1.15 *Residential building* means a structure or portion of a structure which provides facilities or shelter for human residency, except that such term does not include any multifamily residential structure of more than three stores above grade.

1.16 *ANSI Standard C82.2–1984* means the test standard published by the American National Standard Institute (ANSI), titled "American National Standard for Fluorescent Lamp Ballasts—Method of Measurement, 1984", and designated as ANSI C82.2–1984.

2. Test conditions. The test conditions for testing fluorescent lamp ballasts shall be done in accordance with the American National Standard Institute (ANIS) Standard C82.2–1984, "American National Standard for Fluorescent Lamp Ballasts—Methods of Measurement," approved October 21, 1983. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from ANSI Publication Sales, 1430 Broadway, New York, NY 10068. Copies may be inspected at the Department of Energy, Freedom of Information Reading Room, Room 1E–190, Fluorescent Lamp Ballasts, Docket No. CE–RM–89–102, 1000 Independence Avenue, SW, Washington DC 20585, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202–741–6030, or go to: *http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html.* Any subsequent amendment to this standard by the standard-setting organization will not affect the DOE test procedures unless and until amended by DOE. The test conditions are described in sections 4, 5, 6, 7, and 21 of ANSI Standard C82.2–1984.

3. Test Method and Measurements.

3.1. The test method for testing fluorescent lamp ballasts shall be done in accordance with ANSI Standard C82.2–1984.

3.2 *Instrumentation.* The instrumentation shall be as specified by sections 8, 9, 10, 11, 12, 19.1, and 23.2 of ANSI Standard C82.2–1984.

3.3 *Electric Supply.*

3.3.1. *Input Power.* Measure the input power (watts) to the ballast in accordance with ANSI Standard C82.2–1984, section 3.2.1(3) and section 4.

3.3.2 *Input Voltage.* Measure the input voltage (volts) (RMS) to the ballast in accordance with ANSI Standard C82.2–1984, section 3.2.1(1) and section 4.

3.3.3 *Input Current.* Measure the input current (amps) (RMS) to the ballast in accordance with ANSI Standard C82.2–1984, section 3.2.1(2) and section 4.

3.4 Light Output.

3.4.1 Measure the light output of the reference lamp with the reference ballast in accordance with ANSI Standard C82.2–1984, section 16.

3.4.2 Measure the light output of the reference lamp with the test ballast in accordance with ANSI Standard C82.2–1984, section 16.

4. Calculations.

4.1 Calculate relative light output:

$$\frac{\text{Photocell output of lamp on test ballast}}{\text{Photocell output of lamp on ref. ballast}} \times 100 = \textit{relative light} \text{ output}$$

Where:

photocell output of lamp on test ballast is determined in accordance with section 3.4.2, expressed in watts, and photocell output of lamp on ref. ballast is determined in accordance with section 3.4.1, expressed in watts.

4.2. Determine the Ballast Efficacy Factor (BEF) using the following equations:

(a) Single lamp ballast

$$BEF = \frac{\text{relative light output}}{\text{input power}}$$

(b) Multiple lamp ballast

$$BEF = \frac{\text{average relative light output}}{\text{input power}}$$

Where:

input power is determined in accordance with section 3.3.1,

relative light output as defined in section 4.1, and

average relative light output is the relative light output, as defined in section 4.1, for all lamps, divided by the total number of lamps.

4.3 Determine Ballast Power Factor (PF):

$$PF = \frac{Input\ power}{\text{Input voltage} \times \text{input current}}$$

Where:

Input power is as defined in section 3.3.1,

Input voltage is determined in accordance with section 3.3.2, expressed in volts, and

Input current is determined in accordance with section 3.3.3, expressed in amps.

[54 FR 6076, Feb. 7, 1989, as amended at 56 FR 18682, April 24, 1991; 69 FR 18803, Apr. 9, 2004; 70 FR 60412, Oct. 18, 2005]

APPENDIX D – ENERGY INDEPENDENCE AND SECURITY ACT OF 2007

On December 19, 2007, the President signed into law the Energy Independence and Security Act of 2007 (EISA 2007) (P.L. 110-140). This legislation amended certain aspects of EPCA, including, in particular, the potential amendment of existing testing requirements for fluorescent lamp ballasts (see section 310 of EISA 2007) and addition of mandatory efficiency standards for metal halide lamp fixtures (*see* section 324 of EISA 2007). Among other things, the new standard for metal halide lamp fixtures establishes requirements for the efficiency of the ballasts installed in metal halide lamp fixtures. DOE is aware that some companies that produce fluorescent lamp ballasts may also manufacture metal halide lamp ballasts and fixtures; therefore, the entirety of EISA 2007 section 324 is included here for reference.

SEC. 310. STANDBY MODE.

Section 325 of the Energy Policy and Conservation Act (42 U.S.C. 6295) is amended—

(1) in subsection (u)—

(A) by striking paragraphs (2), (3), and (4); and

(B) by redesignating paragraphs (5) and (6) as paragraphs (2) and (3), respectively;

(2) by redesignating subsection (gg) as subsection (hh);

(3) by inserting after subsection (ff) the following:

`(gg) Standby Mode Energy Use-

`(1) DEFINITIONS-

`(A) IN GENERAL- Unless the Secretary determines otherwise pursuant to subparagraph (B), in this subsection:

`(i) ACTIVE MODE- The term `active mode' means the condition in which an energy-using product—

`(I) is connected to a main power source;

`(II) has been activated; and

`(III) provides 1 or more main functions.

`(ii) OFF MODE- The term `off mode' means the condition in which an energy-using product—

`(I) is connected to a main power source; and

`(II) is not providing any standby or active mode function.

`(iii) STANDBY MODE- The term `standby mode' means the condition in which an energy-using product—

`(I) is connected to a main power source; and

`(II) offers 1 or more of the following user-oriented or protective functions:

`(aa) To facilitate the activation or deactivation of other functions (including active mode) by remote switch (including remote control), internal sensor, or timer.

`(bb) Continuous functions, including information or status displays (including clocks) or sensor-based functions.

`(B) AMENDED DEFINITIONS- The Secretary may, by rule, amend the definitions under subparagraph (A), taking into consideration the most current versions of Standards 62301 and 62087 of the International Electrotechnical Commission.

`(2) TEST PROCEDURES-

`(A) IN GENERAL- Test procedures for all covered products shall be amended pursuant to section 323 to include standby mode and off mode energy consumption, taking into consideration the most current versions of Standards 62301 and 62087 of the International Electrotechnical Commission, with such energy consumption integrated into the overall energy efficiency, energy consumption, or other energy descriptor for each covered product, unless the Secretary determines that—

`(i) the current test procedures for a covered product already fully account for and incorporate the standby mode and off mode energy consumption of the covered product; or

`(ii) such an integrated test procedure is technically infeasible for a particular covered product, in which case the Secretary shall prescribe a separate standby mode and off mode energy use test procedure for the covered product, if technically feasible
.

`(B) DEADLINES- The test procedure amendments required by subparagraph (A) shall be prescribed in a final rule no later than the following dates:

`(i) December 31, 2008, for battery chargers and external power supplies.

`(ii) March 31, 2009, for clothes dryers, room air conditioners, and fluorescent lamp ballasts.

`(iii) June 30, 2009, for residential clothes washers.

`(iv) September 30, 2009, for residential furnaces and boilers.

`(v) March 31, 2010, for residential water heaters, direct heating equipment, and pool heaters.

`(vi) March 31, 2011, for residential dishwashers, ranges and ovens, microwave ovens, and dehumidifiers.

`(C) PRIOR PRODUCT STANDARDS- The test procedure amendments adopted pursuant to subparagraph (B) shall not be used to determine compliance with product standards established prior to the adoption of the amended test procedures.

`(3) INCORPORATION INTO STANDARD-

`(A) IN GENERAL- Subject to subparagraph (B), based on the test procedures required under paragraph (2), any final rule establishing or revising a standard for a covered product, adopted after July 1, 2010, shall incorporate standby mode and off mode energy use into a single amended or new standard, pursuant to subsection (o), if feasible.

`(B) SEPARATE STANDARDS- If not feasible, the Secretary shall prescribe within the final rule a separate standard for standby mode and off mode energy consumption, if justified under subsection (o).'; and

(4) in paragraph (2) of subsection (hh) (as redesignated by paragraph (2)), by striking `(ff)' each place it appears and inserting `(gg)'.

SEC. 324. METAL HALIDE LAMP FIXTURES.

(a) DEFINITIONS.-- Section 321 of the Energy Policy and Conservation Act (42 U.S.C. 6291) (as amended by section 322(a)(2)) is amended by adding at the end the following:

`(58) BALLAST.-- The term `ballast' means a device used with an electric discharge lamp to obtain necessary circuit conditions (voltage, current, and waveform) for starting and operating.

`(59) BALLAST EFFICIENCY.--

`(A) IN GENERAL.-- The term `ballast efficiency' means, in the case of a high intensity discharge fixture, the efficiency of a lamp and ballast combination, expressed as a percentage, and calculated in accordance with the following formula: Efficiency = P_{out}/P_{in}.

`(B) EFFICIENCY FORMULA.-- For the purpose of subparagraph (A)--

`(i) P_{out} shall equal the measured operating lamp wattage;

`(ii) P_{in} *shall equal the measured operating input wattage;*

`(iii) the lamp, and the capacitor when the capacitor is provided, shall constitute a nominal system in accordance with the ANSI Standard C78.43-2004;

`(iv) for ballasts with a frequency of 60 Hz, P_{in} and P_{out} shall be measured after lamps have been stabilized according to section 4.4 of ANSI Standard C82.6-2005 using a wattmeter with accuracy specified in section 4.5 of ANSI Standard C82.6-2005; and

`(v) for ballasts with a frequency greater than 60 Hz, P_{in} and P_{out} shall have a basic accuracy of ±0.5 percent at the higher of--

`(I) 3 times the output operating frequency of the ballast; or

`(II) 2 kHz for ballast with a frequency greater than 60 Hz.

`(C) MODIFICATION.-- The Secretary may, by rule, modify the definition of `ballast efficiency' if the Secretary determines that the modification is necessary or appropriate to carry out the purposes of this Act.

`(60) ELECTRONIC BALLAST.-- The term `electronic ballast' means a device that uses semiconductors as the primary means to control lamp starting and operation.

`(61) GENERAL LIGHTING APPLICATION.-- The term `general lighting application' means lighting that provides an interior or exterior area with overall illumination.

`(62) METAL HALIDE BALLAST.-- The term `metal halide ballast' means a ballast used to start and operate metal halide lamps.

`(63) METAL HALIDE LAMP.-- The term `metal halide lamp' means a high intensity discharge lamp in which the major portion of the light is produced by radiation of metal halides and their products of dissociation, possibly in combination with metallic vapors.

`(64) METAL HALIDE LAMP FIXTURE.-- The term `metal halide lamp fixture' means a light fixture for general lighting application designed to be operated with a metal halide lamp and a ballast for a metal halide lamp.

`(65) PROBE-START METAL HALIDE BALLAST.-- The term `probe-start metal halide ballast' means a ballast that--

`(A) starts a probe-start metal halide lamp that contains a third starting electrode (probe) in the arc tube; and

`(B) does not generally contain an igniter but instead starts lamps with high ballast open circuit voltage.

`(66) PULSE-START METAL HALIDE BALLAST.--

`(A) IN GENERAL.-- The term `pulse-start metal halide ballast' means an electronic or electromagnetic ballast that starts a pulse-start metal halide lamp with high voltage pulses.

`(B) STARTING PROCESS.-- For the purpose of subparagraph (A)--

`(i) lamps shall be started by first providing a high voltage pulse for ionization of the gas to produce a glow discharge; and

`(ii) to complete the starting process, power shall be provided by the ballast to sustain the discharge through the glow-to-arc transition.'.

(b) COVERAGE.-- Section 322(a) of the Energy Policy and Conservation Act (42 U.S.C. 6292(a)) is amended--

(1) by redesignating paragraph (19) as paragraph (20); and

(2) by inserting after paragraph (18) the following:

`(19) Metal halide lamp fixtures.'.

(c) TEST PROCEDURES.-- Section 323(b) of the Energy Policy and Conservation Act (42 U.S.C. 6293(b)) (as amended by section 301(b)) is amended by adding at the end the following:

`(18) METAL HALIDE LAMP BALLASTS.-- Test procedures for metal halide lamp ballasts shall be based on ANSI Standard C82.6-2005, entitled `Ballasts for High Intensity Discharge Lamps--Method of Measurement'.'.

(d) LABELING.-- Section 324(a)(2) of the Energy Policy and Conservation Act (42 U.S.C. 6294(a)(2)) is amended--

(1) by redesignating subparagraphs (C) through (G) as subparagraphs (D) through (H), respectively; and

(2) by inserting after subparagraph (B) the following:

`(C) METAL HALIDE LAMP FIXTURES.--

`(i) IN GENERAL.-- The Commission shall issue labeling rules under this section applicable to the covered product specified in section 322(a)(19) and to which standards are applicable under section 325.

`(ii) LABELING.-- The rules shall provide that the labeling of any metal halide lamp fixture manufactured on or after the later of January 1, 2009, or the date that is 270 days after the date of enactment of this subparagraph, shall indicate conspicuously, in a manner prescribed by the Commission under subsection (b) by July 1, 2008, a capital letter `E' printed within a circle on the packaging of the fixture, and on the ballast contained in the fixture.'.

(e) STANDARDS.-- Section 325 of the Energy Policy and Conservation Act (42 U.S.C. 6295) (as amended by section 310) is amended--

(1) by redesignating subsection (hh) as subsection (ii);

(2) by inserting after subsection (gg) the following:

`(hh) METAL HALIDE LAMP FIXTURES.--

`(1) STANDARDS.--

`(A) IN GENERAL.-- Subject to subparagraphs (B) and (C), metal halide lamp fixtures designed to be operated with lamps rated greater than or equal to 150 watts but less than or equal to 500 watts shall contain--

`(i) a pulse-start metal halide ballast with a minimum ballast efficiency of 88 percent;

`(ii) a magnetic probe-start ballast with a minimum ballast efficiency of 94 percent; or

`(iii) a nonpulse-start electronic ballast with--

`(I) a minimum ballast efficiency of 92 percent for wattages greater than 250 watts; and

`(II) a minimum ballast efficiency of 90 percent for wattages less than or equal to 250 watts.

`(B) EXCLUSIONS.-- The standards established under subparagraph (A) shall not apply to--

`(i) fixtures with regulated lag ballasts;

`(ii) fixtures that use electronic ballasts that operate at 480 volts; or

`(iii) fixtures that--

`(I) are rated only for 150 watt lamps;

`(II) are rated for use in wet locations, as specified by the National Electrical Code 2002, section 410.4(A); and

`(III) contain a ballast that is rated to operate at ambient air temperatures above 50°C, as specified by UL 1029 2001.

`(C) APPLICATION.-- The standards established under subparagraph (A) shall apply to metal halide lamp fixtures manufactured on or after the later of--

`(i) January 1, 2009; or

`(ii) the date that is 270 days after the date of enactment of this subsection.

`(2) FINAL RULE BY JANUARY 1, 2012.--

`(A) IN GENERAL.-- Not later than January 1, 2012, the Secretary shall publish a final rule to determine whether the standards established under paragraph (1) should be amended.

`(B) ADMINISTRATION.-- The final rule shall--

`(i) contain any amended standard; and

`(ii) apply to products manufactured on or after January 1, 2015.

`(3) FINAL RULE BY JANUARY 1, 2019.--

`(A) IN GENERAL.-- Not later than January 1, 2019, the Secretary shall publish a final rule to determine whether the standards then in effect should be amended.

`(B) ADMINISTRATION.-- The final rule shall--

`(i) contain any amended standards; and

`(ii) apply to products manufactured after January 1, 2022.

`(4) DESIGN AND PERFORMANCE REQUIREMENTS.-- Notwithstanding any other provision of law, any standard established pursuant to this subsection may contain both design and performance requirements.'; and

(3) in paragraph (2) of subsection (ii) (as redesignated by paragraph (2)), by striking `(gg)' each place it appears and inserting `(hh)'.

(f) EFFECT ON OTHER LAW.-- Section 327(c) of the Energy Policy and Conservation Act (42 U.S.C. 6297(c)) is amended--

(1) in paragraph (8)(B), by striking the period at the end and inserting `; and'; and

(2) by adding at the end the following:

`(9) is a regulation concerning metal halide lamp fixtures adopted by the California Energy Commission on or before January 1, 2011, except that--

`(A) if the Secretary fails to issue a final rule within 180 days after the deadlines for rulemakings in section 325(hh), notwithstanding any other provision of this section, preemption shall not apply to a regulation concerning metal halide lamp fixtures adopted by the California Energy Commission--

`(i) on or before July 1, 2015, if the Secretary fails to meet the deadline specified in section 325(hh)(2); or

`(ii) on or before July 1, 2022, if the Secretary fails to meet the deadline specified in section 325(hh)(3).'.

APPENDIX E – LIST OF ITEMS FOR COMMENT

This appendix lists all the items for comment contained in this Fluorescent Lamp Ballast Framework Document, and the page numbers on which those items for comment can be found.